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CHRONIC NON-TUBERCULOUS INFLAMMATION OF THE LUNG[1]

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IN working with lung diseases, the conviction has been growing on me that we do not need improvement in x-ray technic so much as we need a more intimate knowledge of tissue changes and the ability to interpret the shadows we now obtain in terms of a thoroughly familiar histopathology. In the roentgenology of chest lesions, we have centered our attention too much on securing films in faster time and with finer detail, and have devoted entirely too little study to the pathologic genesis of the several disease processes. It would be embarrassing to many of us if asked to give a detailed description of the microscopic changes in an acute inflammation of the lung parenchyma, or the tissue alterations which occur when such an acute inflammation changes to chronic inflammation. Yet that knowledge is more essential to the accurate interpretation of lung shadows on the roentgenogram than is the securing of extra fine detail or contrast. Until we are thoroughly familiar with the differences in cellular response following the entrance of silica dust, tubercle bacilli, or monilia into the lung tissues, no refinement of technic in the production of films will improve our ability to differentiate the shadows of silicosis, tuberculosis, and fungus infection in the lungs. Furthermore, we will not acquire this essential pathologic knowledge by reading text-books or from the all too infrequent fine descriptions in medical articles, unless this is supplemented by personal study of gross pathologic specimens and stained sections. We must be able to visualize clearly the histogenesis of inflammatory processes in the lungs, if we hope to advance beyond stereotyped mediocrity in the interpretation of x-ray densities. Rather than a five-thousand-dollar equipment to make chest films in a hundredth of a second, the best investment that any x-ray laboratory not already so equipped could make would be a two-hundred-dollar microscope plus the ability and willingness on the part of the roentgenologist to use it constantly.

We have a few excellent examples of pathologic knowledge personally acquired and efficiently applied by roentgenologists to their problems. To mention three will be sufficient for illustration: Dunham's work on pulmonary tuberculosis, which was itself based on Miller's monumental researches into the microscopic anatomy of the lung; Pancoast and Pendergrass's work on pneumoconiosis, and, outside the lung-field, Cole's work on gastric ulcer. Quoting William Snow Miller, "For the correct interpretation of roentgenograms [of lungs] definite knowledge of the distribution of the bronchi, the arteries, the veins, the lymphoid tissue, the lymph follicles and the lymph nodes within

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the normal lung is absolutely necessary; for it is impossible correctly to understand the pathological without a previous knowledge of the normal." Assuming all that roentgenologists doing work with lung diseases are thoroughly familiar with lung anatomy as taught by Miller, it is just as essential to know from observation under the microscope what is happening in the alveoli, the capillaries, the lymphatics, the lymph follicles, and the lung reticulum, in the various types of lung inflammation, if we expect to summarize these intelligently in a visible lung shadow and interpret the sum total from the x-ray film as a probable definite kind of lung lesion.

For these reasons, this paper will attempt no categorical presentation of nontuberculous inflammation, but a brief and general discussion of the changes produced in the lungs by chronic inflammation, suggesting things we have yet to learn, rather than reviewing the few things we actually know about such lesions.

Adami's definition of inflammation seems to be the most pertinent to x-ray findings of any which we have: "The local or adaptive changes resulting from actual or referred injury." Not a word is wasted in this definition and every word is meaningful. Inflammation is a tissue change and it is the local change, as distinguished from infection, which embraces also the systemic reaction. Such local changes are adaptive, representing the attempt on the part of the cells and tissues to adjust themselves so as to resist the injury and render it innocuous. Inflammation follows injury, whether traumatic, physical (heat, cold, electric, or metabolic), or microbic invasion. Such an injury may be at the spot or may be referred from a distance. There are two grades of inflammation—acute and chronic—which merge imperceptibly into each other, and since chronic inflammation is but the continuation of the adaptation to acute injury, we cannot understand chronic inflammation without a knowledge of the acute stage.

The adaptive reaction to local injury, which is the basic change in all inflammation, is better understood if we will recall what happens in a very simple organism. In the larva of the simple metazoon *Astropecten*, there is a single layer of ectodermic cells invaginated at one end into a very primitive endoderm. Within the primitive mesodermic cavity are wandering cells which thus early in the evolutionary process have developed phagocytic powers. If a small foreign body gains entrance to this cavity, these wandering cells attempt to deal with it. If the foreign body is small it may be ingested by one of the phagocytes and destroyed; if it is too large for this, the cells surround it, fuse into a multinucleated mass, and fix the foreign body in one position—a very primitive granulation or cicatricial tissue.

In the more complex organisms, the mesodermal tissue still performs this adaptive and protective function, through the activity of white blood cells, connective tissue cells (reticulum), and certain constituents of the circulating fluids. The difference between that which takes place in the primitive organism and in the human lung is one of degree only and due to the greater complexity of the tissue structure of the lung. The basic biologic reaction is the same in both instances.

If the inflammatory reaction in one of the tissues used in physiological laboratories for this purpose is observed, the same reaction can be seen, modified only by the presence of blood vessels and a more complex organization. When a local injury is inflicted on such a tissue, the series of changes taking place in the arterioles and capillaries is designed to bring to the spot of injury the same mesodermal cells, and to create conditions which will best permit the tissues injured to adapt themselves to the harmful agent. Following the primary arteriolar contraction, the capillaries dilate and the blood stream slows, the blood cells are rearranged with leukocytes peripheral and erythrocytes central; the leukocytes then migrate and fluids exude into the intercapillary reticulum, after which the same cellular reac-

tions that occur in the primitive organism take place here. The purpose of the complex arrangement of blood vessels under the control of nerves and internal secretions is to transport the blood cells and fluids to and from the point of injury; both cells and fluids leave the capillaries and invade the mesodermal connective tissue reticulum, where their essential functions are performed. When white blood cells are present in excess, or when their work is completed, they return by way of the lymphatic channels to the blood stream. This was beautifully demonstrated by the work of Menken and Freund, who showed that the efferent lymphatic channels surrounding any zone of inflammation are packed full of polymorphonuclear white cells returning to the blood stream.

There are four degrees of acute inflammation, all pertinent to an understanding of lung lesions.

(*a*) In the simplest type, such as a cut without bacterial invasion, the above outlined process occurs with leukocytes and serum migrating into the intercapillary connective tissue; fibrin is liberated, sealing the edges of the cut, fibroblasts proliferate and interlace across the cut while new epithelial cells cover the defect on the surface; the slight débris of dead cells is phagocytozed and removed, the fibrin is absorbed, and the injury is healed.

(*b*) If there has been loss of tissue (local necrosis), with or without bacterial invasion, the reaction is simply greater in degree; more leukocytes migrate to the spot and more fluid is exuded; the dead tissue is either removed by phagocytosis or is dissolved and carried away by the lymphatics; after three or four days, a zone of less débris appears at the edge of the tissue destruction where it adjoins the living cells; this bordering zone is composed of newly formed capillaries, held together by a very fine connective tissue reticulum, and is the granulation tissue which does not arise from migrating leukocytes, but must grow from the surrounding healthy tissue; the cells of this connective tissue reticulum (fibroblasts) finally change into white connective tissue or cicatrix.

(*c*) Suppurative inflammation is the third stage of the same process. When leukocytes are attracted to a point of injury in great numbers and many of them die, the phagocytosis and dissolution of cells cannot keep pace, and we will find an opaque fluid at the point of inflammation, consisting of dead and dying leukocytes and débris suspended in exuded plasma; this opaque fluid is the familiar pus. Usually this degree of inflammation is due to bacterial invasion and growth and occurs in an orderly manner. Organisms first grow at the point of invasion and destroy tissue cells for a time before adaptive reactions develop; when bacterial toxins are sufficiently diffused to arouse the reaction of chemotaxis, leukocytes are drawn out of the surrounding capillaries in large numbers, completely crowding out the tissue cells. Many leukocytes are destroyed, new ones pouring in, and the efferent lymph channels become engorged with phagocytic débris. Should the adaptive resistance of the leukocytes and tissue cells succeed in halting the spread of the bacterial invasion, a localized abscess or ulceration will result, with pus formation. When repair of this abscess or ulceration occurs, the bacteria become fewer and fewer, the undestroyed leukocytes and débris are carried away into the lymph channels, and granulation tissue repair proceeds.

(*d*) The fourth degree of acute inflammation is represented by progressive extension of the inflammation without successful arrest or abscess formation.

Chronic inflammation represents the persistence of an injury which cannot be entirely eliminated, the adaptive changes merging gradually into a continual sequence in which the connective tissue cells take the dominant part. The polynuclear phagocytes of acute inflammation first disappear, being replaced by mononuclear cells, such as the large and small lymphocytes and the clasmatocytes of

the reticulo-endothelial system. The reticular connective tissue next increases in amount, its fibroblasts multiplying and finally developing white connective tissue. These changes may continue indefinitely, if bacteria continue to grow in the tissues or other fibroblastic stimuli persist.

When we attempt to apply these very elementary facts about inflammation in general to lung inflammation in particular, we at once realize the necessity for correlating them with histologic anatomy. Fortunately for those who wish to pursue this quest, the work of Miller has made this part of the journey easy, and his classic descriptions are available to every one. We can here only recall the importance of the unit of lung structure—the lobule—and the relations between alveoli, pulmonary artery, and pulmonary vein, with the location of lymphoid follicles, and especially the reticulum of the lung which fills all the space between these structures and is the essential tissue in the changes produced by chronic inflammation in the lung parenchyma.

Further review of the changes in acute inflammation in the lung cannot be made, except to recall that the air-containing alveoli modify the usual inflammatory reaction by offering a path of less resistance into which the cells and fluids pour. When acute inflammation becomes chronic, the air cells open up by absorption of this exudate, and the essential changes continue in the lung reticulum.

Atkinson states that chronic lung inflammation or fibrosis may arise from any one of six causes. Even if this grouping should not include all cases, it will be sufficient for our consideration:

(1) Following acute respiratory infections.
(2) Tuberculosis.
(3) Syphilis.
(4) Pneumoconiosis.
(5) Irritant gases.
(6) Fungus infections.

The work of Dunham and Miller on tuberculosis and of Pancoast and his associates on pneumoconiosis furnish an excellent foundation on which to build the study of chronic lung inflammation. In beginning the study of the histogenesis of chronic lung inflammation one can do no better than start with the known facts about the cellular reactions following the inhalation of silica dust into the lung alveoli. In addition to the reports by Pancoast and Pendergrass, other excellent articles are those by Boisliniere (1933), Friedlander (1928), Meriwether and Sayers (1931), Britton and Head (1931), Lynch and Smith on asbestosis (1930), Russell (1930), Gardner (1929), Chapman (1932), Lemon and Higgins (1932), Ohman (1928), and others.

In the experimental observations of Lemon and Higgins a suspension of barium sulfate colored with India ink was inhaled by anesthetized dogs, and within forty minutes these particles had been carried to the lung periphery. The defense mechanism consisted (1) in removal of particles from the lung alveoli by phagocytes of endothelial origin (clasmatocytes); (2) transportation of the dust by lymphatic drainage; (3) encapsulation of the particles by fibrosis. Attention is called to the fact that this is exactly what occurs in the primitive metazoon larva, and it will be found that this process, modified only by tissue complexity, is what takes place in any lung inflammation. The endothelial cells, or clasmatocytes, are now recognized as being of mesenchymal origin, the same as the lining cells of the alveoli. When foreign particles or bacteria invade the alveoli, these lining cells shed and become actively phagocytic, being replaced by more embryonic cells of the interalveolar septum. These phagocytes pass freely back through the alveolar wall and into the lymphatics.

When silica dust enters the alveolus, the resulting reaction closely resembles chronic bacterial inflammation. The dust is first removed as a foreign body by phagocytes and carried to lymph follicles. There the silica particles are partly dissolved by the alkaline tissue fluids and the resulting

solution has much the same effect as a bacterial toxin. The first phagocytes to appear are polymorphonuclear; the clasmatocytes appear later, are extremely active, break up less readily, and may become transformed into fibroblasts. The poison resulting from the disintegration of silica is a fibroblastic stimulant, leading to a progressive fibrosis which continues as long as the irritant remains. The changes found in pneumoconiosis, especially of the silicotic variety, are due to progressive fibrosis in the lung reticulum rather than to mechanical injury of the dust itself. The mottling which is so familiar is caused by fibrotic nodules which have formed about invisible dust accumulations in lymph follicles. In the anthracotic form of pneumoconiosis, the dust particles are not soluble and therefore not toxic, the densities observed being due to mechanical accumulations of coal dust.

The histogenesis of the tubercle, as described by Dunham, is quite similar. When tubercle bacilli are inhaled, they are removed from the alveoli by the same type of mononuclear phagocyte and are lodged in the lymphoid follicles, where they are surrounded and finally encased in a fibrotic nodule. The tuberculous process, like silicosis, spreads along the lymphatics. The chemical poison of dissolved silica is quite diffusible and produces a generalized peribronchial fibrosis accentuating the fine linear markings of the peribronchial tree before the familiar nodular fibrotic lesions appear. Tuberculosis differs from silicosis in a more localized lesion and in the greater accumulation of tissue fluids from allergic dilatation of blood vessels and exudation of plasma into the interalveolar tissues, producing the familiar hazy cloud studded here and there by the denser shadows of single or conglomerate tubercles.

If we will look at one of Miller's illustrations showing the respiratory bronchus and vein and will imagine tubercles developing wherever lymphoid follicles appear, and the whole area suffused with edematous fluid from lymph stasis, we will have something like the condition exhibited by a typical tuberculosis. Ordinarily what we see is the fan-shaped area of an edematous secondary lobule, studded here and there by the denser primary lobules. Silicotic densities are quite similar, as we would expect them to be, when we consider that the cellular response in the two diseases are almost identical, silicosis lacking only the allergic diffuse cloudiness. The film of a silicotic lung, in any localized area, shows little to distinguish it from tuberculosis. The history, the appearance of the lung as a whole, the sizes of nodules, and the accompanying findings must make the differentiation.

The simplest and perhaps the commonest type of non-tuberculous inflammation is that which is secondary to upper respiratory infection. The localization in the lung may take place by inhalation or through blood stream metastasis. The density of such a lesion is usually regarded as due to atelectasis in a secondary lobule, or to uniform filling of the alveolar structure with inflammatory exudate, producing a localized homogeneous density. The inflammatory process may take one of three courses, according to the three degrees of inflammation previously mentioned:

(1) The lesion may resolve and entirely disappear.

(2) It may pass into the stage of chronic inflammation, with fibrous tissue replacing normal lung tissue and producing more or less permanent densities of the cicatricial type; this may result in deformities of the bronchi and bronchiectasis. The active parenchymal inflammation may disappear, leaving the deformed bronchi which can be recognized only when outlined by opaque oil. The fibrotic changes in the lungs may be very extensive and the inflammation may continue as a progressive chronic disease, in which the bronchiectatic element may or may not be important.

(3) The parenchymal lesion may suppurate and form abscess; this may evacuate and heal or may remain as a permanent

cavity. Sweany and his associates have described a chronic bronchopneumonia with progressive abscess formation, caused by the Friedlander bacillus, which is difficult to distinguish from fibro-cavernous tuberculosis on the x-ray film. It was once thought that when cavitation was found associated with silicosis, a complicating tuberculosis could safely be presumed. With the demonstration that Friedlander's bacillus can produce chronic progressive cavitation in the lungs, usually starting at the apex and developing downward, this point needs further study. Lung lesions from upper respiratory infection have been written about by Stewart and Platou (1929), Dunham and Skavlem (1922, 1927, 1928), Kistner (1927), Preston (1927), Atkinson (1925), Manges (1930), and others.

In lung syphilis we lack a close correlation between the histologic pathology and the x-ray findings. Carrera, in 1925, furnished us with a very excellent pathologic research into the tissue changes of lung syphilis, but these were not correlated with roentgenographic densities. In general, we know that the method of invasion of lung tissue by syphilitic infection must necessarily differ from the method of invasion by tuberculosis or silicosis. Dust and tubercle bacilli are inhaled into the lung alveoli, are taken up by phagocytes, and pass through the lymphatic system. Syphilis is blood-borne and its lesions are perivascular. Although the histologic appearances of tuberculosis and syphilis are quite similar, there is enough difference in the method of spread, taken in conjunction with the peculiarities of lung architecture, to make us anticipate a different type of density. Grossly, tuberculosis is carried by the lymphatics to the lung periphery and gradually works back toward the hilus, producing a fan-shaped shadow with base outward. Syphilis infiltrates along the blood vessels, tending to show its heaviest shadow at the lung hilum with radiations into the lung-field; if its shadows are at all pyramidal the apex is more likely to be outward. Resolution under treatment tends to confirm the diagnosis, just as it would any other lesion suspected of being syphilitic.

Mycotic infections of the lung is a large and increasingly important subject. We have seen actinomycosis, blastomycosis, coccidiosis, moniliasis, and spirochetosis all mistakenly diagnosed as tuberculosis and sent to the Southwest for climatic treatment, when they might just as well have been treated at home by iodides and radiation. In one small tuberculosis sanatorium in Arizona, during the past seven years, the enterprising medical staff members have isolated eleven cases of bronchomoniliasis, most of whom were sent there with a diagnosis of tuberculosis.

In closing, it is necessary only to repeat that there is much for us to learn about lung inflammation and our house of knowledge cannot be constructed from the roof down, but must be built from the ground up, and on the solid rock of gross and microscopic pathology, if it is expected to withstand the storms of criticism or the changing tides of time.

DILATATION OF THE LEFT AURICLE TO THE RIGHT[1]

By JOHN C. RUDDOCK, M.D., F.A.C.P., *Los Angeles*

DILATATION of the left auricle to the right was first described and reported by Owen and Fenton, in 1901. They described and reported the clinical and anatomic features of this condition, as demonstrated in a woman patient aged 40 years, and laid stress upon the finding of a systolic pulsation and thrill in the right axilla, with dullness at the right base suggesting pleural effusion.

Since their description, similar cases have been reported from time to time. Even in its earliest stages, before obvious physical signs begin to appear, projection of the left auricle to the right is demonstrable with a relative degree of certainty by x-ray examination.

This condition has received wider recognition in France and Germany than in England or America, because of greater perfection of technic in radioscopic methods of examination of the heart. Bordet, in a large series of cases of mitral stenosis examined by x-ray methods, found in 5 per cent of the cases examined, extension of the left auricle to the right, beyond the right auricle.

It has long been recognized that, in the presence of definite obstruction to the free flow of blood through the mitral orifice, the first of the cardiac chambers to be affected by the altered relations of intracardiac pressure is the left auricle, its increase in size largely being the result of dilatation (Fig. 1).

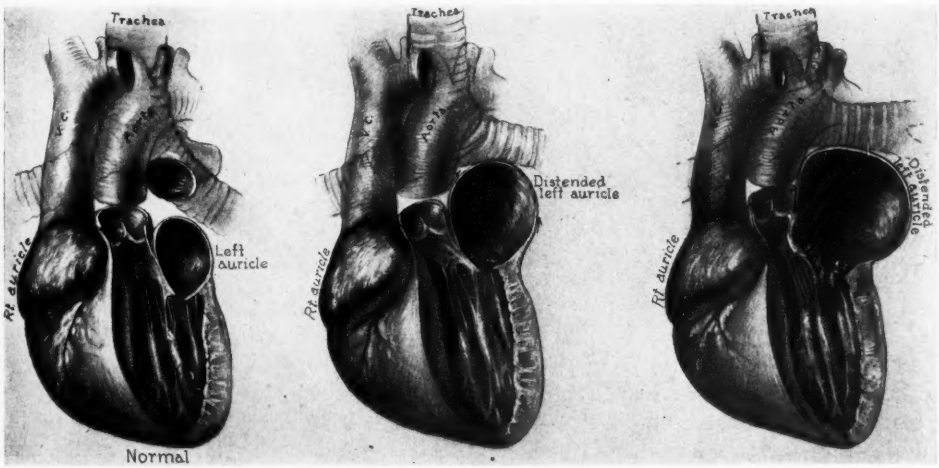

Fig. 1. Schematic drawing, showing the dilatation of left auricle with the closure of the mitral orifice.

This dilatation, with its accompanying volume increase, causes more work by the right side of the heart, which, if the process has had an insidious onset, results in an enlargement due to hypertrophy of the right ventricle. The individual heart, however, remains compensated unless there is a failure of the right ventricle or the tricuspid valve.

With the advent of exacting methods of heart measurement by means of x-rays, it is evident that the relations of the various heart chambers must be definitely known so that the appearance of the heart

[1] Read before the General Medicine Section of the California Medical Association at the Sixtieth Annual Session, San Francisco, April 27–30, 1931.

shadow on the x-ray film may be correctly interpreted (Fig. 2).

It is also evident that the relationship of the right, at the point of attachment of the vena cavæ with the right auricle.

In a case of compensated mitral ste-

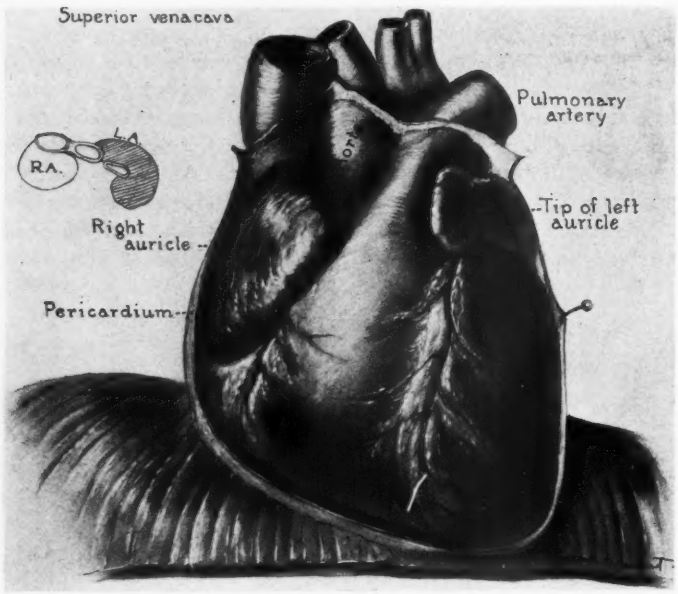

Fig. 2. Drawing showing anterior view of normal heart with diagram of relation of right and left auricles.

the heart chambers is materially changed in compensated and decompensated cases, and also that the relationship of the various other chambers are materially changed because of individual hypertrophy or dilatation due to failure of specific valves.

In describing the upper chambers of the heart, we have named and spoken of the right and left auricles, but it would be more exact to rename them as the anterior right auricle and the posterior left auricle, because in the latter, almost the entire auricle lies posteriorly.

It is a well known fact that dilatations of the left auricle cause an encroachment on the retro-cardiac mediastinal space, and even moderate enlargement may cause a pressure on nerves, blood vessels, bronchi, and esophagus. The junction of the left border of the right auricle with the right border of the left auricle is on the posterior aspect of the heart, and, to

nosis in which only the left auricle is extremely dilated, this junction is pushed anterior and to the right, and at the same time the dilated left auricle obliterates the retro-cardiac space. This pushes forward the right auricle, so that in extreme cases it lies almost entirely anterior (Fig. 3).

The roentgenogram in the anteroposterior view will then show the projecting left auricle forming either a part, or the whole, of the right border of the cardiac shadow, and producing a sharply convex bulge to the right (Fig. 4).

The convex bulge is present because the lower portion of the junction of the right and left auricles is held stationary by the inferior vena cava as it comes through the diaphragm, and the bulging must take place above by pushing the superior vena cava forward and to one side. The maximum projection to the right is usually then some inches above the diaphragm

level, and the cardiohepatic angle is thus acute. In extreme degrees of enlargement, the left auricle may form the whole right border of the heart outline. In enlargement of lesser degree, the left auricle projects to the right above the right auricle, which forms the lower part of the right border of the cardiac shadow. This is true only in cases of mitral stenosis without signs of decompensation. This observation has been made by Assmann, Rösler and Weiss, Rosselet and Bach, Lutembacher, Bordet, Bedford, and others.

When decompensation is present, the left auricle cannot dilate beyond the dilated right auricle; we then have the same relationship that is present in the normal heart. The right border of the cardiac shadow is made by the right auricle, and the acute cardiohepatic angle is obliterated by the distended right auricle, and is visualized as a right or obtuse angle (Fig. 5).

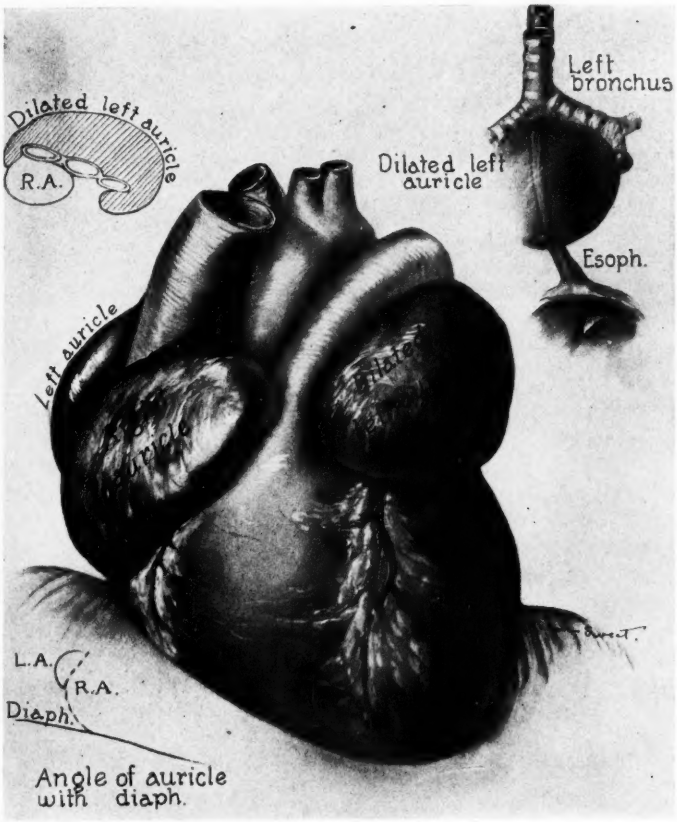

Fig. 3. Drawing showing dilated left auricle, as seen from anterior aspect of heart. The relation of the right and left auricles may also be seen.

The following case exemplifies an extreme grade of this condition:

Case 1. S. A. (Record 642), female, aged 14 years, a Japanese schoolgirl, was one of four children. The child was well and strong until ten years of age, at which time she had chorea, and was sick for one year. Because her pulse was found to be

irregular, and she was markedly dyspneic upon any exertion, she entered the hospital for a complete check-up, at the suggestion of the school physician. Three days after admission, the child suddenly died while playing with a doll in bed.

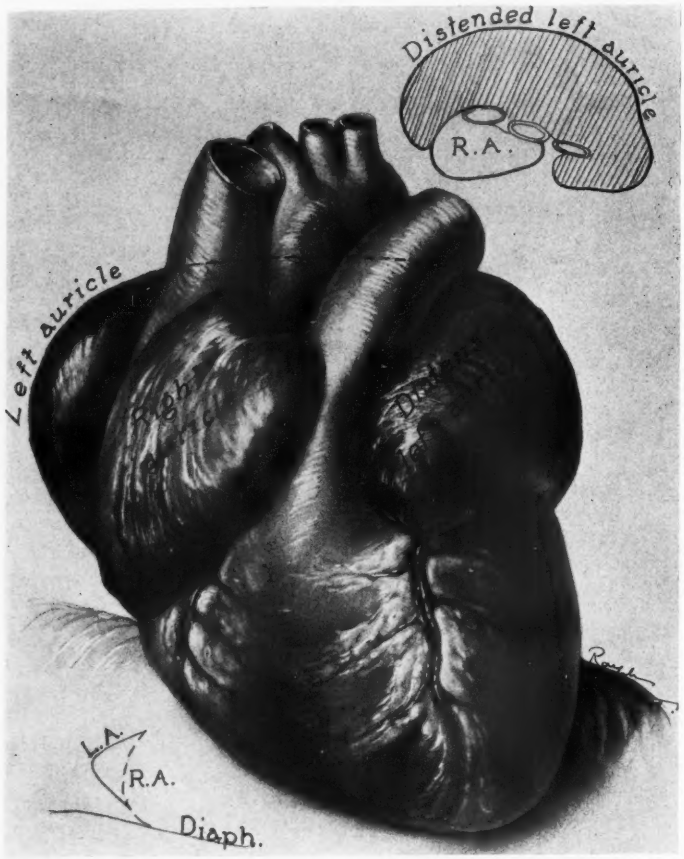

Fig. 4. Drawing of an extreme case of dilated left auricle which is shown making up a large portion of the right border of the heart. The relations of the two auricles are shown diagrammatically.

Examination revealed a pale, slightly built, undernourished Japanese girl, with no cyanosis and no breathlessness while at rest. Her pulse was completely irregular, rate 80. There was a diffuse heaving cardiac pulsation, with apex visible in the sixth interspace at the axillary line; apical diastolic thrill was noted. Loud, low-pitched, rumbling, systolic and diastolic murmurs were heard over the entire precordia, and were transmitted to the left axilla and back. On percussion, dullness was noted to the right of the sternum, and some impairment noted in the right axilla. Lung-fields were clear. No râles or breath changes were noted. There were no signs of congestive failure.

Electrocardiogram showed auricular fibrillation, with right ventricular preponderance. Blood count revealed secondary anemia; urinalysis was normal.

Roentgenograms (Figs. 6 and 7) taken at

six feet revealed a marked enlargement of the right heart shadow, the right enlargement being almost as large as the left. The measurement from the mid-line to the right border was 8 cm., and from the mid-line to the left border, 10.8 cm., making a total of 18.8 centimeters. The measurement of the length of the heart in the lateral view was 19.4 centimeters. On the right side, there was a bulging of the shadow beyond the normal border. This same shadow in the lateral view obliterates the retrocardiac space.

Postmortem examination revealed a markedly enlarged heart, with an extremely dilated left auricle (Fig. 8), which made up the entire posterior portion of the heart and projected back and to the right beyond the border of the right auricle (Fig. 9). Examination of the valves revealed a very high degree of mitral stenosis, with vegetations. In addition to these findings, there was noted a passive congestion in the lungs. The mitral orifice was almost completely closed, admitting only the point of a pencil.

An examination of a number of histories, with an examination of the roentgenograms, at the Los Angeles General Hospital, revealed the fact that cases of mitral stenosis which remain compensated and show an extreme enlargement of the right side of the heart shadow are the result of an enlargement of the left auricle. This causes an acute angle to be formed at the cardiohepatic or diaphragmatic junction. As decompensation progresses, the dilating right auricle obliterates the shadow of the left auricle, as well as the acute cardiohepatic angle, and forms either a right, or obtuse, angle.

In Figure 10 are shown diagrams, drawn to the scale of roentgenograms, of actual cases of mitral stenosis, in varying degrees of decompensation. These diagrams are shown to emphasize the part played by the upper chambers of the heart, in the contour of the heart shadow, as shown by roentgenograms. They illustrate the difference in contour between compensated and decompensated cases, and show the angle produced by the right border of the heart shadow with the diaphragm.

CONCLUSIONS

(1) Dilatation of the right side of the heart, as shown and demonstrated by roentgenologic examination in compensated cases of mitral stenosis, is due to enlargement of the left auricle.

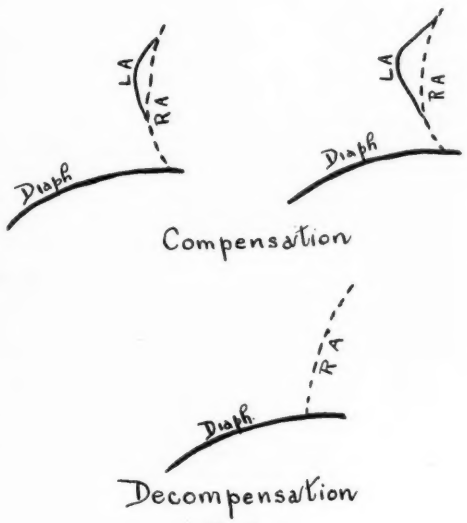

Fig. 5.

(2) Enlargement of the right side of the heart in decompensated cases, as shown by roentgenologic examination, is due to dilatation of the right auricle.

(3) In roentgenograms of cases of mitral stenosis, the cardiohepatic angle is either acute or obtuse and is in direct proportion to the degree of decompensation. In cases in which compensation is complete, the dilatation of the left auricle causes an acute angle, which will be shown by roentgenograms as the cardiohepatic angle. In cases in which there is a decompensation and a resulting dilatation of the right auricle, the angle is either right or obtuse.

(4) Description of the roentgenograms should call attention to the cardiohepatic

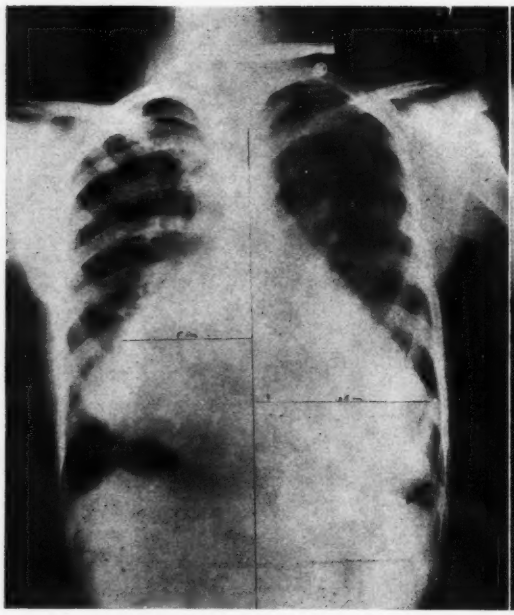

Fig. 6. Anteroposterior roentgenogram, at six ft., of chest in Case 1. This shows an extreme bulging of the right heart shadow, with aneurysmal pouch of the left auricle. Note extremely acute cardio-hepatic angle.

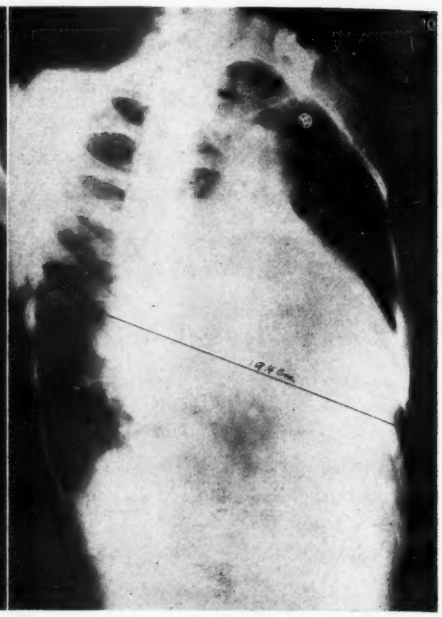

Fig. 7. Lateral view of a six-ft. roentgenogram, in Case 1. Note complete obliteration of retrocardiac space.

Fig. 8. Photograph of heart and lungs in Case 1, posterior view. Note that the entire posterior aspect of the upper chambers of the heart is occupied by the left auricle.

Fig. 9. Photograph of heart and lungs in Case 1, anterior view. Note appearance of left auricle, extending beyond the right border of the right auricle, with the aneurysmal pouch as shown in the x-ray film (Fig. 6).

angle, and the presence of compensation or decompensation must be known before a correct interpretation of the heart contour can be made.

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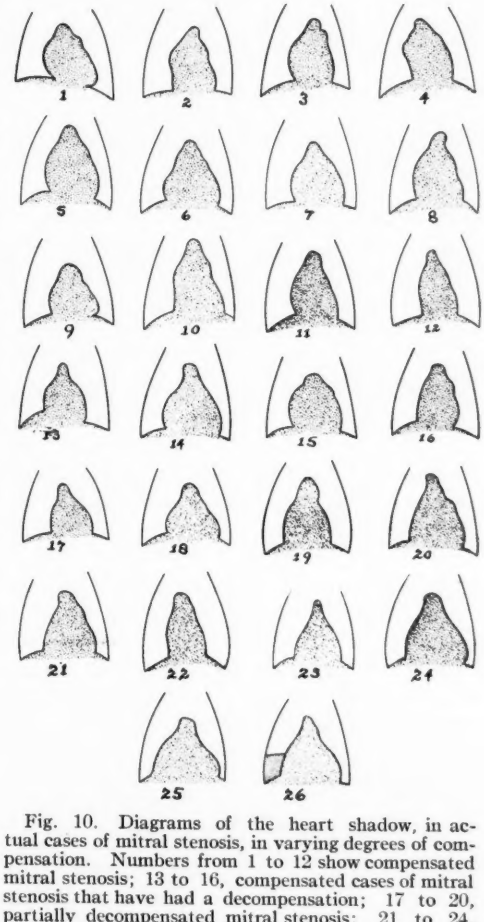

Fig. 10. Diagrams of the heart shadow, in actual cases of mitral stenosis, in varying degrees of compensation. Numbers from 1 to 12 show compensated mitral stenosis; 13 to 16, compensated cases of mitral stenosis that have had a decompensation; 17 to 20, partially decompensated mitral stenosis; 21 to 24, completely decompensated mitral disease; 25 and 26, completely decompensated mitral disease with anasarca.

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AIR DENSITY CORRECTIONS FOR TEMPERATURE AND PRESSURE APPLIED TO X-RAY IONIZATION CHAMBERS

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ABSTRACT

The international roentgen is defined only for a given density (as affected by temperature and pressure) of normally dry air. Since ionization measurements are usually carried out at other than the standard density, corrections must be made therefor. These corrections are discussed and their applications are given for (*a*) standard ionization chamber measurements, (*b*) calibration of thimble chambers against a standard, (*c*) clinical use of thimble chambers at other than the prescribed air density, (*d*) radio-active leaks for ionometer sensitivity control, (*e*) radio-active compensators for ion current measurement.

I.—INTRODUCTION

THE unit of x-ray quantity, the roentgen,[1] has been defined by international agreement in terms of the ionization produced under stated conditions in a cubic centimeter of atmospheric air. The ionization which a given x-ray beam will produce in a given volume of air is simply proportional to the number of molecules of the air exposed to the rays; that is, proportional to the density of the air. The density of atmospheric air depends upon the following factors: (1) composition; (2) moisture content; (3) temperature; (4) pressure. Air composition is extremely uniform for altitudes up to 15 kilometers and over the earth's surface. Ordinary variations in density resulting from change in composition do not affect the ionization produced in air. A change in temperature of 10° C. causes a change in air density due to its moisture content of only about 0.5 per cent. It is, therefore, assumed that air density changes are due entirely to variations in temperature and pressure. The density of unconfined air varies inversely as its absolute temperature and directly as its pressure. The roentgen is, therefore, uniquely defined when these conditions are given. To fulfill this requirement the definition states that the ionization shall be measured in air at a temperature of 0° C. and a pressure of 760 mm. mercury; *i.e.*, air having a density of 0.001293 g./c.c.

In formulating this definition it was not, of course, intended that ionometers should necessarily be calibrated nor that dosage measurements should necessarily be made at 0° C. and 760 mm. pressure, for while not impossible, it would be extremely impractical. It was recognized that, regardless of what temperature and pressure were specified as standard, calibrations and dosage measurements would be made in general under different conditions, and that this would involve temperature and pressure corrections.

Until recently, however, little attention has been given to these corrections, chiefly because they were of about the same order of magnitude as the error involved in the measurements. Now that it is possible to make the measurements within 0.25 per cent, these corrections can no longer be neglected. In the calibration of an ionometer there are three separate temperature and pressure corrections involved: The first is applied to the standard chamber, the second and third to the ionometer reading. These will be discussed in turn and a simplification of the process, arising from the simultaneous application of the first correction factors, will be noted.

[1] "The quantity of radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in one cubic centimeter of atmospheric air at 0° C. and 76 cm. mercury pressure such a degree of conductivity that one electrostatic unit of charge is measured at saturation."

II. TEMPERATURE AND PRESSURE CORRECTION APPLIED TO STANDARD IONIZATION CHAMBER

By the definition of the roentgen, ionization due to "wall effects" is excluded. It is, therefore, to be expected that, in the open-air ionization chamber where this condition is most nearly realized, the ionization produced would vary directly as the density of the air. The density d_0 at 0° C. (273°, absolute) and 760 mm. mercury may be calculated from the density d_t at temperature t° C. (273 + t, absolute) and pressure, p, by the equation[2]

$$d_0 = d_t \left(\frac{273 + t}{273} \times \frac{760}{p} \right). \qquad (1)$$

Since, then, the ionization in the open-air chamber varies directly as the air density, number of roentgens, r, should be given by

$$\begin{aligned} r &= I_0 \\ &= I_t \left(\frac{273 + t}{273} \times \frac{760}{p} \right) \qquad (2) \\ &= I_t k. \end{aligned}$$

Where I_t is the observed ionization per c.c. in e.s.u. at t° C. and p mm. mercury, and I_0 is the corresponding ionization per c.c. in e.s.u. at 0° C. and 760 mm. mercury.[3]

This relationship was tested experimentally first by McClung,[4] in 1904, and by Crowther,[5] in 1909, and found to hold within the experimental accuracy. The factor k is the air density correction which must be applied to the ionization, I_t, measured under any fixed conditions of temperature and pressure, in order to

[2] This equation is an approximation good to about 0.1 per cent. The more exact expression is:

$$d_0 = d_t \, (1 + 0.00367t) \, \frac{760}{p}.$$

[3] To distinguish between I_t and I_0 in (2), Victoreen (RADIOLOGY, November, 1931, p. 1014) refers to I_0 as "roentgens reduced to zero."

[4] R. K. McClung, Phys. Zeit., 1904, **5**, 368. Also, Phil. Mag., 1904, **7**, 81.

[5] J. A. Crowther, Proc. Royal Soc., London, 1909.

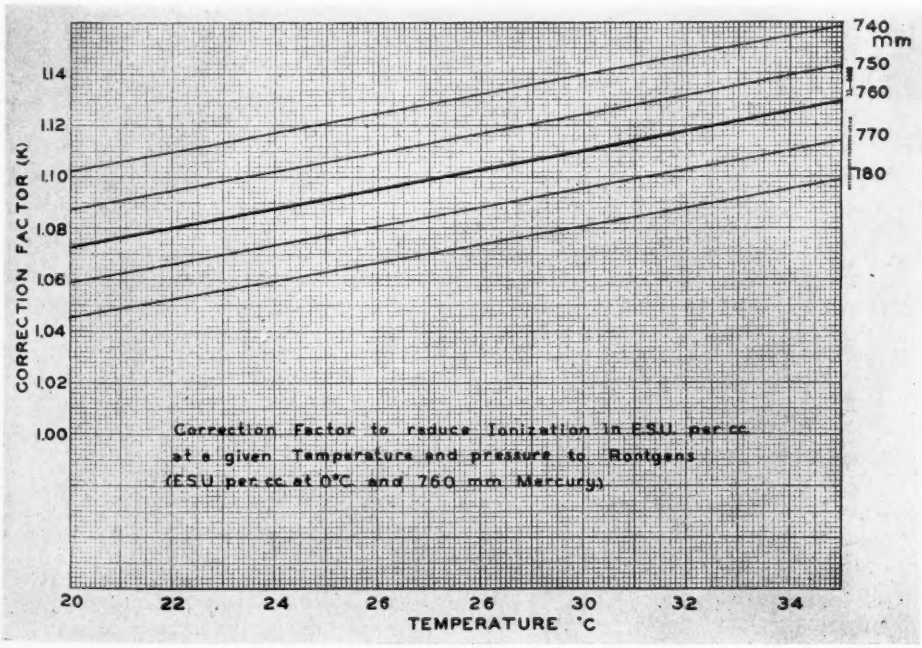

Fig. 1.

determine the value called for by the definition of the roentgen. Values of k for the range of temperatures and pressures ordinarily encountered are plotted in Graph I. This factor, therefore, enables us to determine the x-ray quantity in roentgens under any condition, for we have simply to measure the ionization per c.c. and then multiply by k to get the ionization in e.s.u. at 0° C. and 760 mm. mercury pressure. This by definition gives the x-ray quantity in roentgens.

In the preceding discussion of the temperature-pressure correction, as applied to the standard ionization chamber, it is tacitly assumed that the electrostatic measuring system is independent of temperature and pressure. This assumption holds for all deflection systems, and for *null* systems involving either electrostatic compensators or hermetically sealed radio-active compensators. It does not hold for systems which are not hermetically sealed.

In any radio-active compensator, the current is produced by air ionization which varies according to the same laws as x-ray ionization and, hence, is likewise subject to corrections for air density unless hermetically sealed. In the sealed compensator the density variation is identical with that in the air ionization chamber, so that, when the two are used simultaneously, the air density correction experimentally vanishes. In such a case, however, it is of importance to know the air density for which the compensator calibration was made in order that the readings may be reduced by (2) to the standard density.

III. TEMPERATURE AND PRESSURE CORRECTIONS AS APPLIED TO IONOMETERS

Whether the simple air density corrections which apply for the open-air ionization chamber are also applicable to ionization chambers which are not free from "wall effects," is not known with a high degree of certainty. However, pending experimental proof, it has been universally assumed that the same corrections apply to chambers of the thimble type or others having appreciable "wall effects." The necessity for applying an air density correction when calibrating an ionometer arises from the fact that ionometers are often used at temperatures and pressures other than those at which the calibration is made. If an ionometer receiving a given number of roentgens (r) at known temperature (t_c) and pressure (p_c) gives a scale deflection of θ_c, it would on receiving the same number of roentgens at some other temperature (t_w) and pressure (p_w) give another deflection (θ_w)

$$\theta_w = \theta_c \left(\frac{273 + t_c}{273 + t_w} \times \frac{p_w}{p_c} \right). \tag{3}$$

This correction is applied at the time of calibration of the ionometer against the standard.

Since in general the air density in the clinic will be variable, a second correction *to be applied by the radiologist* may be necessary. This is required if at the time the ionometer is used the temperature (t_a) and pressure (p_a) differ from the temperature (t_w) and pressure (p_w) under which it was *intended* to be used. Thus,

$$\theta_w = \theta_a \left(\frac{273 + t_a}{273 + t_w} \times \frac{p_w}{p_a} \right) \tag{4}$$

$$= \theta_a c'.$$

Ionometers of American manufacture are calibrated for use at 22° C., 760 mm. mercury pressure. For such, Equation (4) becomes

$$\theta_w = \theta_a \left(\frac{273 + t_a}{295} \times \frac{760}{p_a} \right)$$

$$= \theta_a \left(2.576 \times \frac{273 + t_a}{p_a} \right)$$

$$= \theta_a c. \tag{5}$$

The correction factor in (5) (quantity in parenthesis) is usually obtainable, for the range of temperature and pressure conditions ordinarily encountered, from a chart

supplied by the manufacturer. It may likewise be obtained from Graph II. Ionometers graduated to read roentgens directly can be correct only at the temperature and pressure at which it is intended that they be used. Under other conditions, corrections must be made either by Equation (4), (5) or from the chart supplied by the manufacturer.

It should be emphasized that the radiologist need make only one of the corrections discussed above and then only when high accuracy is desired. For small variations in temperature (±3° C.) about the calibrated operating temperature (22° C.), the error introduced by neglecting the air density corrections will be only ±1 per cent. Similarly a variation in atmospheric pressure of ±10 mm. Hg. will introduce an error of about ±1 per cent. The sum of these errors will usually lie within the experimental error of an ionometer as used clinically.

IV. APPLICATION OF AIR DENSITY CORRECTIONS TO CALIBRATION OF AN IONOMETER

Let it be required to calibrate an ionometer to measure roentgens correctly at a temperature t_w and pressure p_w. The temperature at the time of calibration is t_c and the pressure p_c. The ionization current produced by a constant x-ray beam is first measured by means of a standard ionization chamber which indicates 1 e.s.u. per c.c. of air per minute. The ionometer is then placed in this beam and after m minutes shows a deflection of θ_c.

Correcting the standard chamber magnitude, the number of roentgens (r) entering the ionometer in m minutes is determined from Equation (2),

$$r = Im \times \left(\frac{273 + t_c}{273} \times \frac{760}{p_c}\right). \qquad (6)$$

The deflection of the ionometer θ_w for the specified working conditions (t_w, p_w),

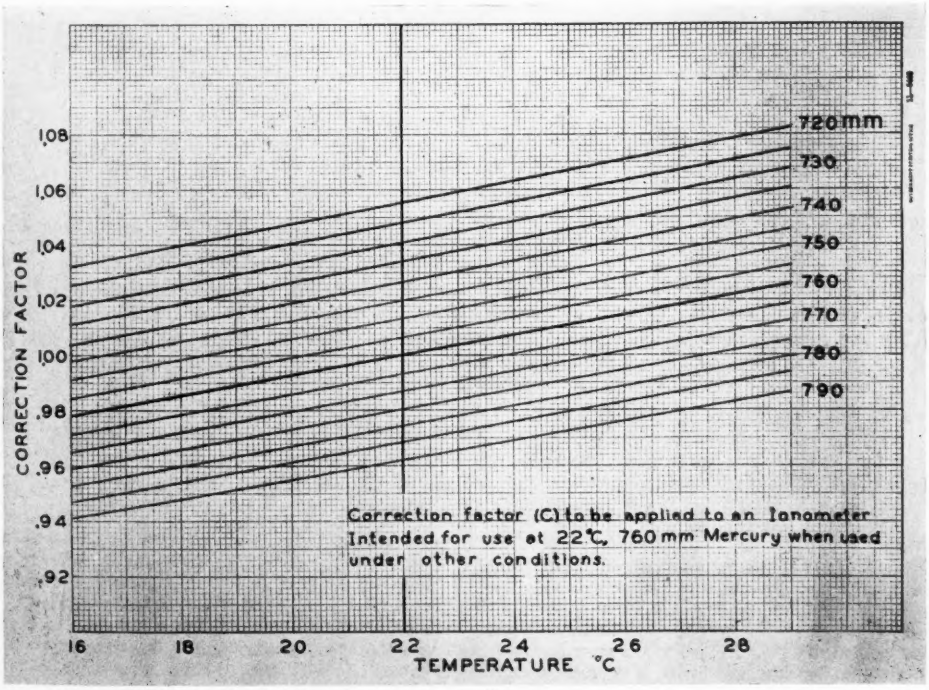

Fig. 2

when receiving r (roentgens), should be from Equation (3),

$$\theta_w = \theta_c \left(\frac{273 + t_c}{273 + t_w} \times \frac{p_w}{p_c} \right). \qquad (7)$$

The number of roentgens per scale deflection of the ionometer (under conditions t_w, p_w) is obtained by dividing Equation (6) by Equation (7)

$$\frac{r}{\theta_w} = \frac{Im}{\theta_c} \left(\frac{760}{273} \times \frac{273 + t_w}{p_w} \right)^{*6} \qquad (8)$$

V. TEMPERATURE-PRESSURE CORRECTIONS APPLIED TO RADIO-ACTIVE IONOMETER CONTROLS

Since ionometers are for the most part delicate instruments it is essential that some means be provided for occasionally checking their calibration. Radium or some other radio-active substance is usually provided as such a control. Since the ionization produced by the control follows the same law as for x-ray ionization,

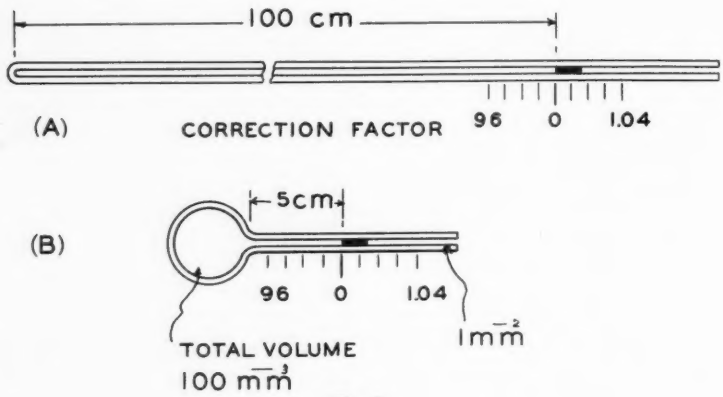

Fig. 3.

It is of interest to note that Equation (8) does not involve either the temperature (t_c) or pressure (p_c) under which the calibration is made and that there is, therefore, no need for knowing the temperature and pressure at the time of calibration.[7]

similar temperature and pressure corrections are applicable.

It is, therefore, recommended that air density corrections on radio-active controls be made in the same manner as the corresponding corrections applied to ionometers. At the initial calibration, the scale deflection produced by the radio-active control per unit time (ratio of deflection to time) should be found, and

*6 For all ionometers of American manufacture and for those calibrated at the Bureau of Standards, t_w is 22° C. and p_w is 760 mm. of mercury. Equation (8) then becomes

$$\frac{r}{\theta_w} = \frac{Im}{\theta_c} \frac{295}{273} = (1.081) \left(\frac{Im}{\theta_c} \right).$$

[7] W. Nicholas of this laboratory has suggested and used a simple means of obtaining the air density correction without actually measuring the temperature and pressure. A globule of mercury in a capillary tube sealed at one end (Fig. 3-*A*) will move according to the air density in the tube, which will, of course, vary with temperature and atmospheric pressure. If, for example, the tube has a uniform cross-section and the globule is 100 cm. from the sealed end, each centimeter of motion of the globule will represent about 1 per cent change in air density, giving directly the correction necessary to apply to the ionization readings. A modification of this suggestion would be to replace the long tube by a capillary and bulb of known volumes (Fig. 3-*B*) so as to reduce the size of the apparatus. Such a device may be mounted directly on an ionometer for convenience.

by means of Equation (3) should be corrected to the conditions of temperature and pressure (t_w, p_w) for which it is intended that the ionometer be used. When at any time the ionometer is to be checked by this control the deflection-time ratio must again be determined for existing temperature and pressure conditions (t_a, p_a) and this ratio by means of Equation (4) reduced to the working conditions (t_w, p_w). By this means a check obtained from a control of this type has a real significance; a good agreement between the initial check and that obtained later (both for conditions t_w, p_w) indicating that the calibration of the ionometer has remained unchanged. Capacity controls have recently been incorporated in certain ionometers which do not require corrections for temperature or pressure.

VI. CONCLUSIONS

Of the temperature-pressure corrections discussed, that to be applied to the standard ionization chamber—correcting from 0° C. to room temperature—is by far the most important; under ordinary conditions it amounts to about +8 per cent.

In order to measure dosage accurately by means of an ionometer which has been calibrated in roentgens, the following factors must be known: (1) the temperature and pressure for which it is intended that the ionometer be used; (2) the actual temperature and pressure at the time the ionometer is used.

In order to effect an accurate calibration of an ionometer by means of a standard chamber the temperature and pressure at the time of calibration need not be known.

The temperature-pressure correction to be applied to an ionometer will vary from about −2.0 per cent to +4.0 per cent. For extremes in temperature and for the low atmospheric pressures at high altitudes this correction may be as large as +7.0 per cent.

REDUNDANT DUODENUM: A ROENTGENOLOGIC STUDY[1]

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MUCH has been written in recent years on duodenal anomalies. The roentgen-ray examination offers a reliable method for a thorough investigation of the duodenum. Abnormalities of this portion of the small bowel are frequently overlooked, principally because of the fact that the examiner concentrates his attention on the first part of the duodenum. It is quite probable that were the entire duodenum studied with the same meticulous care, many more instances would be discovered. Anomalies of the duodenum are far more common than is indicated by a survey of the literature. Of these, the redundant duodenum is of especial interest. It is a condition in which there is usually an elongation of the superior portion of the duodenum with a ptosis of the mid-portion of the superior segment resulting in an anomalous loop. Recently (1,2) we have called attention to this malformation and its clinical significance, and have established this anomaly as a roentgenologic entity.

The normal duodenum, about 27 cm. in length, has a definite anatomic configuration in the form of a "C," or incomplete circle. In this anomaly the superior aspect of the duodenum is lengthened. The duodenum lends itself easily for roentgen examination, and any abnormality may readily be disclosed by this method of investigation.

The duodenal cap or first portion of the duodenum which normally represents the superior duodenum is surmounted upon the pyloric outlet. It is about 5 cm. in length and presents itself in the form of a cone, with its base at the pylorus and apex forming the first duodenal angle. From the apex, the duodenum as a rule makes a sudden drop and is usually directed to the right of the cap and somewhat posteriorly. It is held in place by the hepato-duodenal ligament, which represents the free margin of the lesser omentum. In the redundant duodenum the normal configuration is quite altered because of the marked elongation of the superior segment. Any portion of the duodenum may be involved, but this malformation is more commonly found in the superior part. Since the superior duodenum is lengthened, another angle is formed to the right of and posterior to the first angle, which is held in place by the hepato-colic ligament. The distance between the two angulations varies according to the length of the superior duodenum and the size of the ptosed loop. The elongated portion of the superior duodenum varies in length from 5 to 10 cm., which measurement is exclusive of the bulb. In some instances sharp angulations may exist, but no instances of prolapse of the angles were observed in this study. The resultant picture, as viewed roentgenologically, is a deformity of the superior segment, forming a water-trap effect in which the flow of the contrast meal through the duodenum is delayed.

The incidence of this anomaly in the routine gastro-intestinal roentgen examination is rather small, occurring in about 2.5 per cent in our series of cases.

Roentgen Examination.—The fluoroscopic method of examination is the procedure of choice, giving by far the best visualizations of this anomaly. The duodenal cap or bulb is usually normal in size, but may occasionally be elongated. Beginning at the apex of the cap, the duodenum, instead of making a sudden drop to form the descending arm of the "C," is lengthened in its superior aspect, forming an extra loop. The descending arm of the duodenum is displaced to the right and posteriorly. Two angulations are ob-

[1] Presented before the American Congress of Radiology at Chicago, Sept. 25–30, 1933.

From the Gastro-enterological Section of the Department of Medicine, University of Maryland, Baltimore.

served in the superior duodenum which are fixed by the hepato-duodenal and hepatocolic ligaments which maintain this deformity. Inasmuch as there are two fixed points in the superior duodenum together with unusual lengthening, a ptosis in the mid-portion of the lengthened segment is produced, forming a loop characteristic of a water-trap. The resulting deformity of this anomaly is revealed as a "U," "V," or "M" shape of the superior segment. Instead of the marked ptosis of the redundant part, occasionally, a slight sagging or serpentine form may be noted.

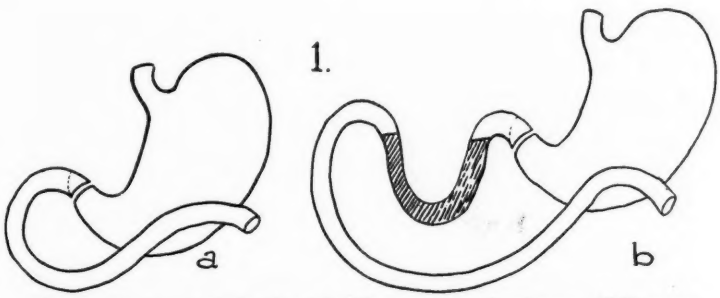

Fig. 1. Diagrammatic drawing (*a*) of the normal duodenal curve; (*b*) illustrates the redundancy of the superior duodenum. Note the two fixed points at the two angulations. The shaded area is the redundant loop producing the water-trap effect, which retards the flow of the contrast meal. Duodenal stasis occurs in this loop.

It is important when making the examination to place the patient in the proper position; this anomaly is best observed in the erect posture. In most instances the oblique projection brings the malformation of the duodenum into view, inasmuch as the duodenum is nearly always directed posteriorly in this affection. On this account the extra loop may be overshadowed by the pylorus or other portions of the duodenum. Frequently the redundant loop may not be visible in the anteroposterior position, and occasionally appears to coalesce with the cap or descending arm of the duodenum and thus may pass unrecognized. The picture at first glance may appear to be due to an enlarged duodenal bulb or a diverticulum, but these may easily be eliminated by manipulation under the fluoroscopic screen. Manipulation of the duodenum with the gloved hand is an important procedure which should be routinely employed in the investigation of the duodenum. The visualization of the entire duodenum is extremely important since other abnormalities may be found associated with redundancy. This anomaly has been variously described as a ptosis, festooning, idiopathic elongation, *M*-deformity, or extra looping.

Considerable interest has been manifested in this malformation because of its association with the disturbance of motility of the duodenum, resulting in the production of duodenal stasis, irritable duodenum, duodenitis, and frequently with ulceration. As a result of prolonged stasis in the duodenum it is not difficult to picture how this factor may easily play an important rôle in the production of such disturbances. Therefore, this anomaly should be given careful consideration, as an early recognition is highly essential in order to eliminate the possibility of associated complications. Duodenal stasis varying from a slight to a moderate degree was observed in every instance. No marked or unusual stenosis was detected. The stasis, which in this instance is due to the ptosed loop which retards the flow, differs from the usual type in that it occurs only in the loop, while the remaining duodenum

is perfectly normal. Usually there is no dilatation of the lumen. The stasis noted in this anomaly simulates a water-trap in which the fluid remains at a certain level, even after the duodenum is completely emptied. Gastric motility was not unduly interfered with, and no gastric retention occurred in our study. No unusual or exaggerated retro-peristalsis was detected. True writhing was not observed, though a slight swaying motion was at times noted in the loop.

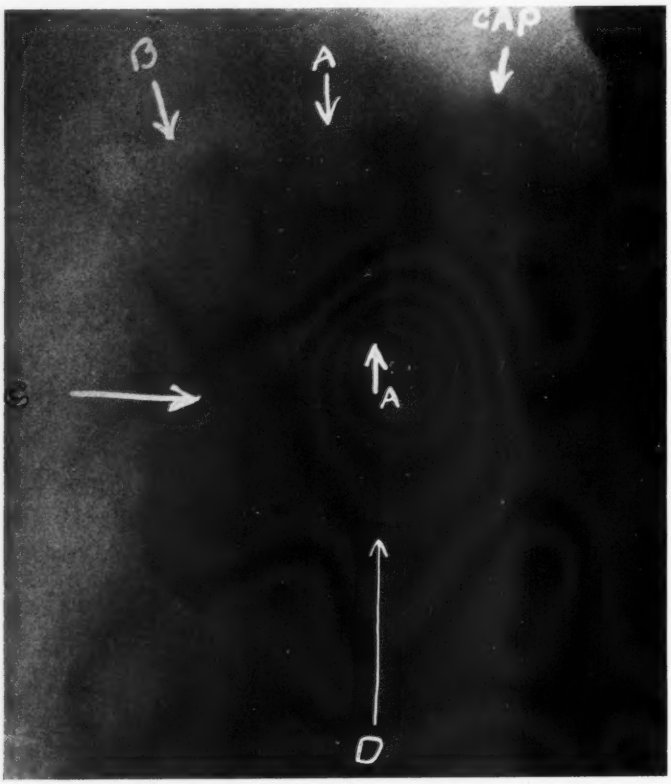

Fig. 2. Roentgenogram demonstrating the typical picture of the redundant duodenum. The two fixed points in the superior duodenum, the two angulations, the extra loop, and the stasis are clearly shown.

Duodenitis was found to be associated with this anomaly in a number of instances, while evidence of marked duodenal irritability was noted in all cases which came under observation. The duodenal cap, though normal in size, revealed evidence of irritability. In many instances the cap showed a fibrillation, transient irregularities, and shifting spastic defects. Frequently it was difficult to differentiate cases in which there was marked irritability of the duodenum from the true form of duodenitis.

The presence of gastric and duodenal ulceration associated with this malformation is a very significant observation. Ulceration occurred in slightly over 41 per cent of the cases in this series.

It was of interest in this study to determine the relation of the position of the stomach and colon to the redundant duodenum: this investigation revealed that

the position of these organs bear no special relationship to redundancy of the duodenum.

The diagnosis of this anomaly must be based almost entirely upon a thorough roentgenologic examination. Although the condition is best recognized by fluoroscopic examination, it may also be recorded upon roentgenograms when the patient is placed in the proper position. The fluoroscopic study most satisfactorily reveals this anomaly in the upright posture, viewed anteroposteriorly, obliquely, and laterally. The puddling of the barium meal in the extra loop is the most striking picture, which at once gives a clue as to the presence of a redundant segment of the duodenum. On manipulation the puddling disappears only to return on the next spurt of barium. A double fixation of the superior duodenum is presented in this group of cases which represents a congenital anomaly. This fixation is due to the presence of peritoneal bands, represented by the hepato-duodenal and hepato-colic ligaments.

Roentgenologically, the redundant loop may be simulated by a number of conditions, such as accessory pocket of a duodenal ulcer, inverted duodenum, dilated duodenal bulb, duodenal diverticula, filled ampulla of Vater, duodenal adhesions, periduodenitis, and various other duodenal distortions and deformities.

SUMMARY

A roentgenologic study of the redundant duodenum is presented. This anomaly, which occurred in about 2.5 per cent of 500 routine gastro-intestinal roentgen studies, is far more common than is indicated from a survey of the literature: it is a roentgenologic entity. The superior portion of the duodenum is the most common segment involved. The malformation produces a looping of the redundant duodenum which results in a water-trap effect, and presents a characteristic roentgen picture. Particularly significant is the association of duodenal stasis and irritable duodenum, with frequent occurrence of ulceration.

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THE RELATIONS OF THE RADIOLOGIST AND THE LAW[1]

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., *Chicago*

THE relations and responsibilities of a radiologist to the law are as a general subject and in a general way, not much more nor less than those of any other medical specialist.

A medical specialist is legally defined as a physician who applies himself to the study and practice of some particular branch of medicine. Being employed by patients or those representing them, because of his peculiar or particular skill and knowledge in that branch of medicine, it naturally follows that his duty to his patients is not measured by the ordinary or average skill and knowledge of physicians; because if he possesses no greater degree of skill or amount of knowledge in his specialty that does the average physician, there would be no reason or motive for his employment, and possessing such additional and greater degree of skill and amount of knowledge it naturally becomes his duty to apply it.

Briefly and succinctly, the standard of skill and knowledge required by the law of a physician who holds himself out as a specialist, is that degree of skill and knowledge which is ordinarily possessed by physicians who devote special attention to the same specialty, under similar conditions and in similar or like locations, and with regard to the present state of medical knowledge. Accordingly, a radiologist who undertakes to make roentgen diagnoses or administer roentgen or other radiation treatment, must exercise in such diagnosis and treatment, the same degree of care, skill, and knowledge as is customarily and usually exercised and applied by radiologists in good professional standing in the same or a similar locality.

Incidentally, *it would be well if this test of skill and knowledge was applied to all who hold themselves out as radiologists, and who accept employment as such, whether they are licensed physicians or mere pretenders, without medical education.*

ESTABLISHED METHODS OF PRACTICE MUST BE FOLLOWED

One of the most rigid rules regarding the practise of medicine, and one pointed out and mentioned in many important legal decisions involving this subject, is *that physicians must follow established methods of practice.* If a physician departs from recognized remedies or methods of treatment or of diagnosis, it is at his own peril and risk, and if such departure results in injury to the person so treated, the physician will be liable for damages however good his intentions may have been. A very good example of how this subject is viewed from the legal side is embodied in the following quotation from a decision by the Wisconsin Supreme Court:[2] "In cases where there can be said to be a thoroughly established and usual method of treating a situation, meaning thereby that a certain mode of treament has been recognized, adopted, and followed by all physicians and surgeons of good standing, *a departure therefrom would be clearly at the risk of the physician venturing to make the same.*"

It is, of course, obvious that in order to make the physician liable because of a departure from established methods, such treatment or departure from established methods must have some deleterious effect or in some way have injured the patient, and *this must be proven.*

THE LAW ALLOWS FOR ERROR

A subject not infrequently brought up for discussion in malpractice suits is re-

[1] Read before the Chicago Roentgen Society, March 3, 1933.

[2] Allen *vs.* Voje, 114 Wis. 1; 89 N.W.R. 924.

garding the results of honest errors in treatment or diagnosis *The law does not expect us to be infallible and makes due allowance for the possibility of humans to err.* There are numerous decisions from courts in all parts of this country, which state in exactly so many words that, "A physician is not an insurer of a cure" or of good results from his treatment or for the correctness of his diagnosis. Consequently, we are not held liable for honest errors of judgment if our methods are along recognized lines, and we have exercised the usual and proper amount of care and skill in the application of these methods. Many State Supreme Courts have rendered decisions which are unusually clear and fair to the medical profession, in their interpretation of the statutes, common law, and other decisions (judge-made laws) in this regard. It has been the writer's privilege to have appeared as a witness several times in the defense of physicians charged with malpractice, and to have advised regarding the conduct and defense of cases on numerous other occasions for alleged malpractice, and we are glad to say that we have found that nearly all of the presiding judges in the trial courts in Illinois, Indiana, Iowa, Michigan, Nebraska, Ohio, Pennsylvania, and Wisconsin where we have been, are amenable to the application of common sense principles and fair mindedness in this particular regard at least.

RES IPSA LOQUITUR?

The doctrine of "*Res ipsa loquitur*" (the thing speaks for itself), when applied to a roentgen-ray injury, is one of the far-too-often-used dicta of the prosecuting attorneys. It has been decided in some States that this doctrine cannot apply when the alleged injury appeared after the use of the roentgen rays for therapeutic purposes, but may apply when the roentgen rays were used for diagnostic purposes. In a few States it has been held by the highest courts that this doctrine cannot apply at all, and in other States (Washington, notably),[3] "The court may refuse to apply that rule in its instructions." It has been the writer's contention that this doctrine should never apply in this sort of case, and we have been able to help some in convincing courts to that effect. However, it is occasionally so evident—when a roentgen dermatitis appears after the use of the x-rays in a diagnostic procedure—that "the thing speaks for itself" (or, as the lawyers have it, *Res ipsa loquitur*) so that unquestionably there may be occasionally a real responsibility with the radiologist, and, try as we may, errors occur, dermatites result, undeniably, damage is done and these cases come up. It is surprising that the lay technicians who are doing so much of this work on their own responsibility do not have more of these injuries than they do. Their apparent freedom must be due to what the Germans speak of as "*Mehr Gluck wie Verstand.*"

RESPONDEAT SUPERIOR

In regard to the responsibility of physicians and surgeons who are employed either full or part time by hospitals, corporations, or clinics, the courts are nearly unanimous in holding that the doctrine of "*Respondeat superior*" (the master is responsible) does not apply. This is unquestionably sound and logical, because in the performance of our professional duties we are not subject to rules and instructions as regards how and when we should perform those duties, as are other employees, and the employers must in the natural order of things rely and depend entirely upon our judgment, for which they should not rightfully be held responsible in the event that we err or fail to apply the necessary degree of skill, knowledge, or judgment. Among some of the recent decisions voicing this opinion are Borgeas *vs.* Oregon Short Line Ry. Co., *et al.* (Ore.), 236 Pac.R. 1069; Parsons *vs.* Yolande Coal & Coke Co. (Ala.), 91 So.R. 493; Black *vs.* Fischer *et al.* (Ga.), 117 S.E.R. 103 and Morrison *vs.* Henke *et al.* (Wis.), 160 N.E.R.

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[3] Stickney *vs.* Congdon *et al.*, 228 Pac.R. 849.

Exceptions to this ruling occur, however, one such case being The Lincoln Park Coal and Brick Co., *vs.* Industrial Commission *et al.* (Ill.), 148 N.E.R. 79, where an employee was required to have a roentgenographic examination made by the coal and brick company's physician. In this case the supreme court looked upon this physician as the agent for and of the employer and the court decided that the employer was responsible for the alleged roentgen injury. Other decisions holding similarly are Garrison *vs.* Everett *et al.* (Neb.), 199 N.W.R. 30, which was a drainage tube case; McMahon *vs.* Carolina Spruce Co. (N. C.), 105 S.E.R. 439, a fracture case and Brown *vs.* Sinclair Refining Co. (Okla.), 206 Pac. R. 1942.

In Wetherington *vs.* Jennings (Mass.), 149 N.E.R. 201, the Supreme Judicial Court of Massachusetts decided that the radiologist in charge of the x-ray department of a hospital was not responsible for error on the part of the technician who administered a roentgen treatment and left out a filter. Both the physician and the nurse were employees of the hospital but the technician was not in the employ of the physician, who was the defendant in this case. Manifestly he should not be held responsible for the acts of a fellow-employee, even if he wrote the prescription for the treatment, especially if his prescription was not properly filled.

OWNERSHIP OF THE ROENTGENOGRAMS

The position of the roentgenologist in regard to the question of the ownership of the films or plates has come up for more or less discussion for many years, and until quite recently has never been decided by any court of record. Several decisions have been recorded wherein it has been adjudicated that photographic negatives belong to the person, firm, or corporation who made them, and the writer has on several occasions been the cause of the withdrawal of legal proceedings aimed to force the delivery of roentgenograms to plaintiffs in malpractice suits, by merely quoting these decisions, and our own arguments which have been expounded at numerous times before medical meetings.

Recently, however, two decisions by Michigan courts seem to put the ownership clearly and flatly in our hands, where the same rightfully belongs. We have for years maintained the position that all negatives, plates, films, prints, etc., are as much a part of the records of the case as are the history sheets, and that as such they are the property of the physician, hospital, laboratory, or clinical group that caused them to be made. No court or attorney has thus far deemed it wise to force any contrary action, although several times we have been threatened with legal action. To fortify our position in this particular, it is only necessary that we have all our bill heads and statements read "Roentgen examination" instead for "films," "plates," or "pictures." If that is done, we have the evidence that the examination was what was charged for and naturally the records should remain in the hands of the maker of them, just as does the record of blood counts, etc.

WE MAY REFUSE TO RENDER SERVICES

Like all other physicians, a radiologist may decline or refuse outright to render services, and he is not legally required to render his services should he for any reason prefer not to do so.

However, if he has agreed to render services, he has assumed a contract so to do and he is liable for any damages which may result from a failure to fulfill or complete his contract.

Any physician in undertaking to treat or diagnose the condition or ailment of any patient, by implication contracts and agrees that he possesses a reasonable amount of skill and knowledge, and that he will apply that skill and knowledge with ordinary care and diligence. If there is any doubt, he is required to use his best judgment. All of these statements apply to radiologists, and, in addition, they are, as specialists, expected to have more than

ordinary skill and knowledge in regard to radiology, and they must apply that more than ordinary skill and knowledge with the care and diligence of specialists in their line in the same or similar localities.

With the few exceptions noted, radiologists have practically the same legal responsibilities as the practitioner of general medicine, along with the additional and added responsibilities of those of a specialist.

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MULTIPLE MYELOMA[1]

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From the New York City Cancer Institute, Department of Hospitals; Ira Kaplan, M.D., Director

MULTIPLE myeloma is a primary malignant tumor of the bone marrow, characterized by multiple foci, pain, spontaneous fractures, Bence-Jones albumosuria, anemia, and asthenia. It occurs chiefly in the ribs, spine, sternum, and pelvis of adults. It is uncommon in occurrence, insidious in onset, difficult to diagnose, and the prognosis is hopeless.

Historical.—Bence Jones, in 1846, first isolated a body in the urine which now bears his name. The disease was first described by MacIntyre, in 1850, under the term "mollities ossium." The name "multiple myeloma" was given by Von Rustizky, in 1873, to the Bence-Jones proteinuria and the multiple bone tumors. Kahler gave a remarkable description of the disease in 1884 and many still call it by his name. In 1905, Woods was able to collect 30 cases; in 1907, Permin had found only 40 cases, and Martini, in 1916, collected 204 case records. With the more extensive use of the x-ray, diagnosis was made more simple and, in 1927, Geschickter and Copeland collected 425 cases, 13 of which were their own.

Pathology.—Grayish and reddish masses appear simultaneously in spongy bone or in the medullary canal and, as they slowly grow, excite active resorption of the bone. Subsequent bending and breaking of the bone take place, due to the loss of mineral salts. Gradual thinning and perforation allow pathologic fractures to occur, though they are accompanied by little or no pain and are followed by soft tumor masses over the bone. William G. MacCallum, in 1901, arrived at the following conclusions concerning multiple myelomas: "The tumors are distinguishable from other malignant tumors by their mode of growth and the absence of metastases; myelogenic sarcomas in particular by their multiplicity and the uniformity of their component cells, giant cells and spindle cells being practically absent. The resemblance of the myeloma cells to those of the bone marrow and, especially the great macroscopic resemblance of the tumors to the adjacent bone marrow, from which they can scarcely be delineated, have given rise to the opinion that they spring from some of the bone marrow cells."

Codman, in 1925, subdivided multiple myeloma into four groups: (1) lymphocytic; (2) myelocytic; (3) erythroblastic; (4) plasma cell. In 1927, Longcope added a fifth group, the myeloblastic type. Nephritis is common. Some cases of amyloid degeneration of the spleen, liver, and kidneys are noted. No soft-tissue metastases are made out, although direct contiguous soft-tissue invasion is possible.

Roentgenology.—The lesions are seen to be punched-out, rarefied areas, not confluent, varying in size, and widely scattered through the skeleton. The cortex is not destroyed, but expansion of the shaft may be noted. Pathologic fractures are common.

Diagnosis.—The condition occurs in patients from 40 to 60 years of age, predominantly in males. Onset is insidious, beginning with vague rheumatic pains, more common in the back. Whitlock, in 1924, suggested that these back pains are caused by erosion of the periosteum or adjacent nerves. In many cases there is a previous history of typhoid or malaria. In cases in which pain is absent or minimal, the roentgen findings may be noted during roentgen study of some internal organ or examination following trauma. Kahn, in 1914, stated: "Often the sequence of events

[1] Read before the Radiological Society of North America at the Eighteenth Annual Meeting, at Atlantic City, Nov. 28–Dec. 1, 1932.

would lead one to construe injury as a direct factor and it is notable that in several cases first attention was drawn to the existence of the disease by some such cause. In Simmond's case a fracture of the arm seems to have played a rôle, while in two of Versé's cases there seems to have been antecedent trauma. In his first case, the lumbar spine was injured and it was there that the most marked pathologic changes were later found; in the second case, a rib was fractured by a blow in the chest."

The presence of Bence-Jones albumosuria is a helpful diagnostic point, but it is not altogether pathognomonic of multiple myeloma. Kahn quotes Bogys and Guthrie, who expressed a view that Bence-Jones proteinuria is not essentially dependent upon one disease, but is a manifestation of disturbances of bone marrow affecting endogenous metabolism.

Differential diagnosis is clinically necessary from special varieties of tabes dorsalis; metastasis from the adrenals, breast, thyroid, or lung; osteomalacia, Paget's disease, syphilis of bone, multiple endothelioma, Hodgkin's disease, and lymphosarcoma. Since multiple myeloma may occasionally accompany other malignancies, especially breast carcinoma, the differential diagnosis may be most difficult.

The prognosis is poor. The duration of life has varied from eight months to from eight to eleven years, with an average of less than two years. Death has occurred from pneumonia and from asthenia. X-ray treatment in light doses relieves the pain markedly and may prolong life. Belden, in 1925, reported the case of a woman of 58, who for three years had had numerous pathologic fractures, which united rapidly and well. Progressive secondary anemia and Bence-Jones bodies were present. The patient was still alive at the time the case was reported.

In the New York City Cancer Institute, Department of Hospitals, we have had about 9,500 admissions since the inception of the Institute in 1923, with 127 primary bone tumors, among which were seven cases of multiple myeloma. Of these, three had positive biopsy or autopsy findings, and in the others the diagnosis was indicated by the clinical findings. The writer, in over ten years' experience in charge of the X-ray Department in the U. S. Veterans' Bureau, New York City Regional Office, has had only one case of multiple myeloma in about 60,000 x-ray examinations, showing the rarity of the condition in clinics and departments where cancer is not the paramount issue.

CASE REPORTS[2]

Case 1. B. E., No. 5,763, white, male, medical student, admitted July 24, 1929, complained of a swelling on the left side of the chest and pain in the left chest, which was constant and increased on deep inspiration. He was treated for pleurisy until the swelling grew larger. In February, 1929, the tumor on the left side of the chest had been removed at Israel Zion Hospital. On operation, a soft spindle-shaped tumor, adherent to the fifth rib and invading the muscles and periosteum, was excised and the rib curetted. Laboratory examination showed the tumor to be a myeloma. While in hospital, the patient developed a hematogenous nephritis. He was often seized with severe attacks of pain in the lumbar region, accompanied by a board-like rigidity of the abdominal muscles. X-ray examination of the genito-urinary tract revealed no urinary calculi. Following this, the entire skeleton was x-rayed and found to be negative. The patient received x-ray therapy to the chest and back, and the pain in the chest and lumbar region subsided. After he left the other hospital on March 12, 1929, he began to lose weight rapidly and became so weak that he was forced to remain in bed. He had frequent high temperature and sweats. During the next few months he had frequent attacks of pain of a drawing character in both thighs and in the right lower chest, the latter worse upon

[2] These cases are from the New York City Cancer Institute.

respiration and pressure. In June, 1929, he received another series of radiation to the chest, neck, and head, but the pains did not subside. The rest of the history is irrelevant.

Physical examination showed an emaciated, anemic young man, who appeared to be very weak. The lower right portion of the chest appeared to be widened anteriorly and laterally, with tenderness to pressure over this area. In the left side, there is a post-operative scar, 3.5 inches long, between the fourth and fifth ribs. A portion of the fifth rib appears to have been removed and in its place a newly formed bony disc may be palpated. The abdomen shows rigidity of the recti muscles. Otherwise the physical examination is negative.

Progress Notes.—On July 25, 1929, urinalysis showed urine negative for albumin, sugar casts, and red blood cells: specific gravity, 1.008. Sputum was negative for tuberculosis.

On July 26, 1929, x-ray examination of the chest and skeleton (including skull) showed an increase in the vertical diameter of the left fourth and fifth ribs, with irregular rarefaction of punched-out variety. This was seen in lesser concentration, scattered through the rest of the ribs. Irregular productive tuberculous foci were noted in the apices.

On July 28, 1929, the blood count was as follows: Hemoglobin, 55 per cent; red blood cells, 3,000,000; white blood cells, 3,200.

On Aug. 5, 1929, no change was noted in the general condition, the patient running an irregular type of fever. A small exostosis was felt in the temporal region.

On Aug. 21, 1929, cystoscopy showed normal findings, except that urine from the right ureter had a pinkish tinge. Urea, right kidney, 9 per cent; left kidney, 10 per cent. Microscopic examination, right side, few red blood and epithelial cells; left side, the same but slightly fewer in number. Gastro-intestinal x-ray examination showed gastric atony, but no organic lesion of the stomach. A slight non-productive cough was noted.

On Aug. 25, 1929, the patient coughed up blood-tinged mucus and a few crepitant râles were heard over the right apex.

On Aug. 26, 1929, an x-ray study of the chest showed no change in the rib condition, but an increase in the lung involvement was noted. Wassermann test was negative. On this day the patient was discharged at his own request.

Comment.—The age of this patient is exceptional for multiple myeloma. Otherwise the clinical course and symptomatology conform to the typical story.

Case 2. M. C., No. 6,303, policeman, age 55, was admitted March 14, 1930, with a complaint of slight bleeding in the throat, dripping down from above onto the tongue; bleeding from the nasal pharynx, and occasionally in slight degree from the right nostril. The condition had begun five months before admission, the frequency of the hemorrhages increasing with time. For the year previous to admission he had been troubled with increased lacrimation of the right eye. There was no history of trauma about the nose. The case had been referred from the Manhattan Eye, Ear, and Throat Hospital, where biopsy had been performed. The patient's past history was as follows: appendectomy and peritonitis, ten years previously; glands removed from right side of neck, twenty years previously. The family history was irrelevant. The local condition showed that in the right nasal fossa, at the anterior end of the middle turbinate, there was a large area covered with dry blood; the left nasal fossa was somewhat reddened, otherwise normal; the throat and tonsils were somewhat reddened; the larynx was somewhat swollen; no palpable glands were felt in the neck; there was a firm fullness in the left supraclavicular fossa. The sputum was negative for tubercle bacilli. Numerous streptococci (in short chains) and diplococci were found.

Progress Notes.—On March 14, 1930, Wassermann and Kahn tests were negative. On March 18, 1930, x-ray exami-

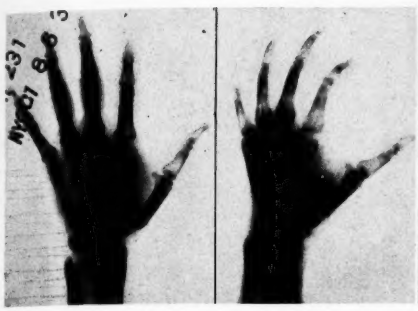

Fig. 1. Case 2. Fusiform cystic enlargement in the head of the right second metacarpal, with distal destruction of the cortex.

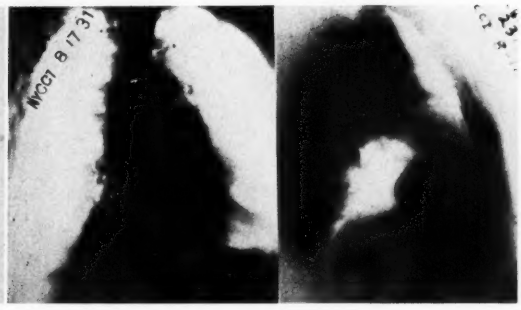

Fig. 2. Case 2. Irregular rarefied circular area in sternum just below the angle of Ludwig.

nation of the sinuses showed right pansinusitis.

On March 22, 1930, biopsy from nose lesion (slide borrowed from Manhattan Eye, Ear, and Throat Hospital) was diagnosed as large round-cell sarcoma by Dr. Douglas Symmers, Director of Division of Pathology, Department of Hospitals.

On May 16, 1930, and again on Oct. 24, 1930, x-ray examination of the chest showed irregular tuberculous productive changes in the upper portions of the upper lobes. Therapy consisted of intra-nasal radium, with several applications of a nasal sound (280 mc.-hrs. on April 9, 1930, and 1,157 mc.-hrs. on April 12, 1930). X-ray therapy was administered to the face and nose (2,400 r) from March 22, 1930, to April 5, 1930, while 2,400 r more were given from Jan. 26, 1931, to Feb. 27, 1931, because of recurrence of bleeding.

On Aug. 6, 1931, the nasal condition was improved. Examination showed a slight redness of the mucosa of the right naris; a protuberance about 1 × 0.5 in., hard, irregular, and bony in consistency, was noted in the upper part of the sternum and to the left of the midline; another protuberance, flatter, but of about the same consistency, shape, and appearance, an inch below the first, but more in the midline; a hard and tender swelling of the right hand just at the proximal joint of the index finger (the patient gave a history of striking that part of the hand about three months before).

X-ray examintions in August, 1931, showed an irregular localized type of rarefaction in the middle and outer portions of the right clavicle and the sternal end of the left clavicle (Fig. 1). In the head of the right second metacarpal and adjacent part of the shaft, there was seen a fusiform enlargement of irregular cystic multilocular type, with destruction of the cortex distally. The proximal phalanges showed a similar but more localized rarefaction without cortical involvement. The same was seen in the lower end of the right radius (Fig. 2). The sternum showed an irregular, circular, rarefied area just below the angle of Ludwig, and a similar deposit was made out in the left ischium, in the body of the last lumbar vertebra, and in both tibiæ, where the lesions appeared larger in size.

On Aug. 28, 1931, the protuberances were seen to be growing larger, and a redness and swelling were noted on the right inner anterior surface of the middle of the tibia. To palpation, it was warm and tender, signs which, the patient said, accompanied the lumps on the chest wall (Fig. 3).

X-ray therapy was given to the legs, sternum, and right hand (2,400 r) from Sept. 23, 1931, to Oct. 26, 1931.

Further x-ray examination on Oct. 5, 1931, revealed numerous punched-out

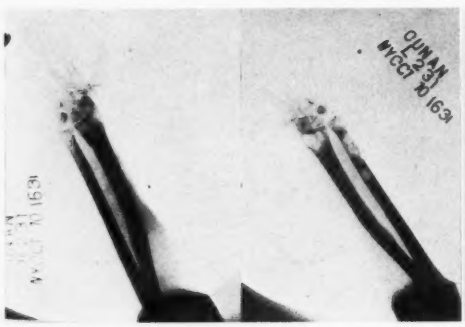

Fig. 3. Case 2. Numerous punched-out rarefied areas in bones of the forearms.

Fig. 4. Case 3. Irregular rarefied lesions in the femora, tibiæ, and fibulæ.

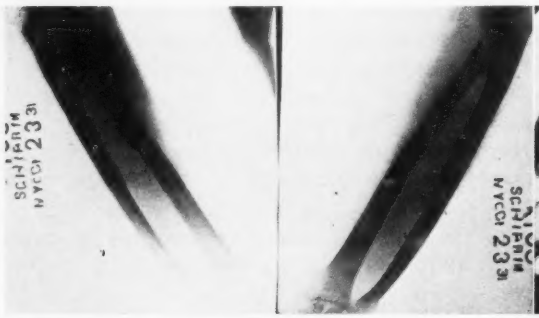

Fig. 5. Case 3. Irregular rarefied lesions in the bones of the forearms.

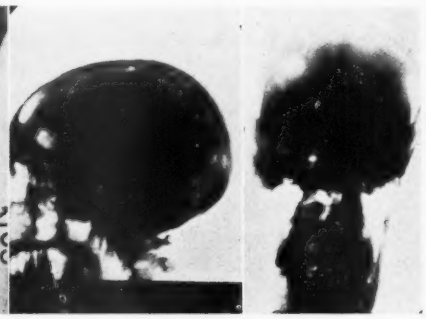

Fig. 6. Case 3. Large rarefied areas in frontal part of the skull.

areas of rarefaction in the bones of the forearms, the humeri, and the skull.

On Nov. 4, 1931, the pelvic pathology showed an increase in size and there was also some evidence of pathology in the upper end of the right femur.

On Nov. 11, 1931, the patient experienced a recurrence of the bleeding. A large area of ulceration was seen on the outer wall of the right nasal fossa, particularly involving the middle turbinate. This area was covered with a greenish-gray mucopurulent slough.

On Dec. 2, 1931, the patient had increased pain in the lower part of the left tibia, and bleeding from the nose continued. Numerous urine examinations were negative for Bence-Jones protein. Numerous blood counts were taken, but they were not significant.

In December more therapy was begun to the same areas treated before (the legs, sternum, and right hand), but was stopped at 400 r units because of the patient's transfer to Bellevue Hospital.

On Dec. 28, 1931, the patient was bleeding profusely from the nose. After packing, he was sent to Bellevue Hospital for transfusion and further treatment.

Comment.—This case is atypical in that its onset was marked with nasal bleeding three years prior to the objective bony changes and the beginning of pain. This man persisted in his work as traffic policeman until the recurrence of nasal bleeding forced him off duty.

Case 3. A. S., No. 7,400, butcher, age 40, was admitted Feb. 3, 1931. Six months before admission the man began to limp and to have pain in the left ankle

joint. A tumor at this joint had been removed at Mount Sinai Hospital four months before and he was able to make his way about on crutches. A slide made at the time of biopsy, borrowed from Mt. Sinai Hospital, shows reticulum cell lymphosarcoma. Five weeks before admission, the right knee began to swell and became tender. On admission, he was unable to move the knee or to endure pressure of the palpating hand. For about twenty years the patient had complained of indefinite gastric distress. Physical examination showed a well nourished adult male, lying quietly in bed. Any motion of the lower extremities caused excruciating pain. There was a two-inch linear scar over the inner malleolus of the left ankle. The right knee showed a fusiform swelling over all aspects, with extreme tenderness extending down the anterior surface of the right leg to the middle third. There was a small protuberance about two inches above the outer end of the right eyebrow; no tenderness of the skull; a soft nodule, apparently a sebaceous cyst about two-thirds of an inch in diameter, was situated about the left labionasal fold. There was pain on pressure over both humeri, femora, and iliac bones.

Progress Notes.—The patient received x-ray treatment at Mount Sinai Hospital over both ankles, the right inguinal area, and the right elbow from July 31, 1930, to Jan. 8, 1931.

The x-ray report of Feb. 3, 1931, reveals generalized destructive bone changes throughout the skeleton, including the skull (Figs. 4, 5, and 6).

On Feb. 11, 1931, the Wassermann test was negative. On Feb. 12, 1931, the patient experienced increased pain all over the skeleton.

On Feb. 19, 1931, he was moribund and cyanotic and the next day he died.

Comment.—In this case, the clinical course favors the impression of multiple myeloma. However, there is a division of opinion, from the microscopic study, in the differential diagnosis between reticulum cell lymphosarcoma and reticulum cell multiple myeloma.

Case 4. G. H., colored male, age 42 years, admitted Oct. 21, 1931, with the chief complaints of pain in the back and right hip following injury six months before, and weakness. In April, 1931, the patient fell down a flight of basement stairs, striking on his right hip. He was confined to bed for about two weeks, after which the doctor sent him to the hospital, where he was kept in bed for three months. The patient continued to have pain in the lower spine and right hip. No incontinence: no blood in the urine. At time of admission to the New York City Cancer Institute he felt a little better but could not walk unless he had support. There was no loss of weight; the bowels were regular. Physical examination showed an obese colored man, appearing to be lame. The head was negative; there was no adenopathy in the neck nor thyroid enlargement. The chest was negative; the heart and lungs were clear; the abdominal wall was so very thick that palpation was unsatisfactory; no masses were detected. There was an ovoid, slightly movable and tender mass in the right groin, measuring about 1 × 1.5 inch, which was apparently the right testicle that was missing from the scrotal cavity; the left testicle was normal. Rectal examination of the prostate showed it to be enlarged, but not hard; there were no lesions in the rectal wall.

Progress Notes.—On March 28, 1932, following a course of x-ray treatments, the patient stated that the pain in the small of the back had diminished.

X-ray examinations (Fig. 7) on Sept. 29, 1931, and Oct. 7, 1931, showed an irregular extensive rarefaction in the pelvis and femora and also in the shafts of the humeri and in the scapulæ. A localized area appeared in the lower end of the left ulna. (The patient was referred to us for x-ray diagnostic work from a City Hospital Dispensary and was subsequently admitted to our Cancer Institute on Oct. 21, 1931.)

On Nov. 5, 1931, x-ray examination of the spine showed that in the left lateral

Fig. 7. Case 4. Extensive multilocular rarefaction of pelvic bones and femora.

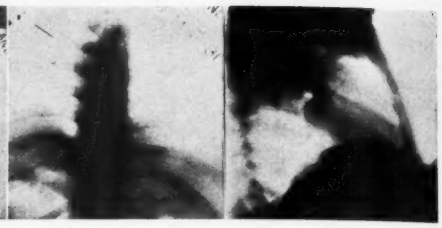

Fig. 8. Case 4. Irregular rarefaction and diminished intervertebral disc space between the tenth, eleventh, and twelfth thoracic vertebræ, with upward and forward angulation of the twelfth thoracic vertebra.

Fig. 9. Case 5. Irregular, extensive, intercommunicating, destructive lesions in the skull at the vertex, varying in size.

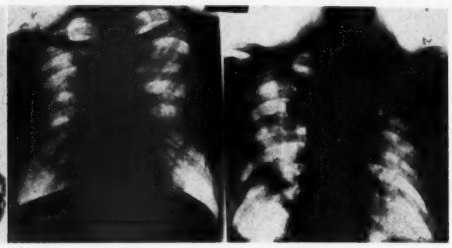

Fig. 10. Case 5. Irregular rarefaction, with swelling in the right first, fourth, seventh, and tenth ribs, and also in the left second and sixth ribs.

portion of the bodies of the tenth, eleventh, and twelfth thoracic vertebræ there appeared an irregular rarefaction, with apparent haziness and diminished intervertebral disc space between the eleventh and twelfth thoracic vertebræ. This coincided with apparent angulation of the twelfth thoracic vertebra upward and forward. The lumbar spine did not show any definite changes. The upper portions of the sacrum revealed a diffuse irregular rarefaction similar to that in the pelvis. In the posterior view there was an irregular rarefactive involvement of the portion of the ribs visualized, most marked in the left tenth, eleventh, and twelfth ribs. The skull showed small irregular rarefactive lesions throughout, most pronounced in the upper parietal region. At this time the involvement of the scapulæ and upper ends of the humeri seemed more pronounced. The bones of the forearms did not show any changes since the last examination. The Wassermann was negative. On admission, the urine was cloudy, specific gravity 1.024, acid, 2 plus albumin. On March 28, 1931, the blood count had been: hemoglobin, 85 per cent; white blood cells, 7,500. X-ray treatment (1,000 r) was given over the right hip and right lumbar spine from Oct. 29, 1931, to Nov. 9, 1931; over lower thoracic area, both shoulders, right and left lateral skull, and left wrist (6,000 r), from Nov. 24, 1931, to March 4, 1932; over lower thoracic region (600 r, incomplete), from March 28, 1932, to April 1, 1932. The patient has failed to return for follow-up study and treatment.

Comment.—Although biopsy was not obtained, yet the course of the symptoms following the onset coincide with the cases of Simmond and Versé quoted by Kahn in which the trauma preceded the condition. In this case a comparison of our findings with the negative records from the hospital where the patient was confined for three months prior to admission to our Institute, shows conclusively that

Fig. 11. Case 5. Irregular destruction in the right side of the sacrum and ilium from crest to acetabulum.

Fig. 12. Case 6. Great enlargement of the sternum below the angle of Ludwig in anteroposterior diameter, by an osteoid spongy material.

the bone involvement was not present originally and that it gradually increased.

Case 5. G. R., No. 8,788, male, age 57, was admitted to the New York City Cancer Institute on Jan. 1, 1932. One year previous to admission he had received an injury to the right chest and he had since suffered from continuous pain there. No cough or expectoration; appetite poor. Since receiving high voltage treatment at Memorial Hospital during the previous four months, he has vomited three times a day. He also received twelve injections of Coley's serum. The pain in the right chest is worse when he stands up and also when he tries to work (dishwasher by occupation). Had biopsy in the right frontal area four months ago. Rest of history irrelevant.

Physical Examination.—Patient is an anemic Greek, twenty years in U. S. A., speaks English imperfectly; appears to be normal mentally. *Eyes:* pupils equal and react to light and accommodation. *Ears, nose:* no discharge. *Teeth:* pyorrhea alveolaris and bleeding from gums. Mucous membrane looks healthy. *Thyroid:* not palpable. *Chest:* resonant, with vesicular type of breathing; few râles at right base posteriorly; no adenopathy; rest of examination negative. On Feb. 12, 1932, the temperature was 106° F.; on Feb. 13, 1932, he still had high temperature; pulse dicrotic; general condition very poor. On Feb. 14, 1932, the patient died.

On Feb. 6, 1932, the Wassermann had been negative. On Feb. 3, 1932, x-ray examination of chest, skeleton, skull, and long bones was as follows (Fig. 9): There was an irregular extensive intercommunicating destructive involvement observed in the skull, chiefly in the frontal parietal at the vertex and also present in the occipital area. The margins of the lesion were well defined in the occipital region, especially appearing isolated in character. The lesions varied in size from a pinpoint to the largest aggregation in the frontal area measuring 9 × 6 cm. in extent. There was curvature of the cervical spine, with convexity to the left in the upper thoracic region, and a distinct vertical compression in the body of the ninth thoracic vertebra. Bodies of the lower thoracic vertebræ were somewhat diffusely increased in density in the posterior projection. The lateral view showed an irregularly diminished density in the bodies of the vertebræ and an irregularity of the cancellous tissue arrangement. *Pelvis* (Fig. 11): An irregular destruction was present involving the right side of the sacrum and ilium from the crest down to the acetabular rim. Irregular punched-out areas and rarefaction were made out in the left humerus, radius, and

ulna. *Ribs* (Fig. 10): An irregular rarefaction of similar localized type was visualized in the chondral end of the right first rib. A large bulging was seen in the posterior central portion of the right seventh rib, with irregular rarefaction in its center. An irregular destructive involvement of similar rarefactive type, with a breaking of the capsule, was observed in the anterior axillary portion of the right fourth rib. A similar moderately large area of rarefaction appeared in the posterior axillary portion of the right tenth rib. In the left side of the central posterior portion of the sixth rib there appeared a similar large bulging, with loss of calcium substance. This was also observed in the anterior condylar portion of the left second rib. The rest of the ribs showed diffuse change in density, with a small area of rarefaction. The lungs were clear. There were extensive multiple foci of multiple myeloma. The urine showed an occasional red blood cell but was otherwise negative. The blood count on Feb. 2, 1932, was as follows: hemoglobin, 65 per cent; red blood cells, 2,900,000; white blood cells, 2,500.

Biopsy at Memorial Hospital showed: tissue from skull, myeloma; cells not typical, but approach the plasma-cell structure; much foreign body reaction due to bone absorption.

Autopsy.—Head: Irregularity noted in left frontal region. *Heart:* Aorta shows atheromatous changes. *Lungs:* free, both upper lobes and left lower lobe well aerated. Right middle and lower lobes show some congestion, with areas of patchy consolidation and grayish discoloration. *Chest:* Several ribs show localized swelling in different locations—the left second rib in the anterior portion, the fourth right rib in the antero-axillary line, the seventh right rib in the posterior portion, etc. *Spleen:* Rather fibrotic and small. *Gall bladder:* Contains stones; ducts are patent; rest of the tissues are normal. *Pathlologic diagnosis:* multiple myeloma and lobular pneumonia. *Histologic diagnosis:* Atypical plasma-cell myeloma of bone and lobular pneumonia. *Report from Memorial Hospital* (review of slides of autopsy by Dr. F. W. Stewart): "Oil emulsion shows cells are atypical plasma cells. An absent Bence-Jones means nothing since fully one-third of the myelomas never show it or show it only occasionally. The old hyaline tissue appears to be degenerated, osteoid bone surrounded by large foreign body giant cells. I don't know whether this is spontaneous or whether it followed radiation, with disappearance of tumor locally and the formation of atypical abortive callus. So far as I can see from the whole evidence at hand myeloma is the best we can do."

Comment.—This case demonstrates the typical clinical course, with onset following injury, and rapid termination by pneumonia and proven by biopsy and autopsy. In this case x-ray treatment was of no avail in stemming the condition.

Case 6. P. B., No. 9,655, housewife, age 48, was admitted to the New York City Cancer Institute, Sept. 14, 1932. The chief complaint was pain in the chest and cough of a year and a half duration. The pain began in the front and lateral regions of the chest. Shortly after the patient began to cough, especially at night, but this stopped after a while. One year ago the patient noticed a mass appearing in the mid-sternal region. A biopsy was performed at the Brooklyn Jewish Hospital and the slide was borrowed from there and diagnosed as myeloma by Dr. Douglas Symmers, Director of the Division of Pathology in the Department of Hospitals of New York City. *Menstrual history:* Two years ago there was profuse vaginal bleeding, gradually diminishing in amount each month, until at present she has only an occasional period, with small amounts of bleeding. There have been present hot flashes and other symptoms of the climacteric. The rest of the history is irrelevant. Physical examination showed bilateral exophthalmos, more marked on the right side, with bilateral palpebral ptosis. The patient complains of a sense of induration in the neck anteriorly. *Chest:* A large

mass is present over the mid-sternal region, extending into both breasts in the upper inner quadrants, which is divided by an indentation in the midline. It is firmly fixed to the subjacent tissues and extends in a diffuse mass into the epigastric region. The liver is enlarged; the rest of the abdomen is negative. A soft tissue mass is felt in the upper lateral aspect of the left leg, firmly fixed to the bony tissues.

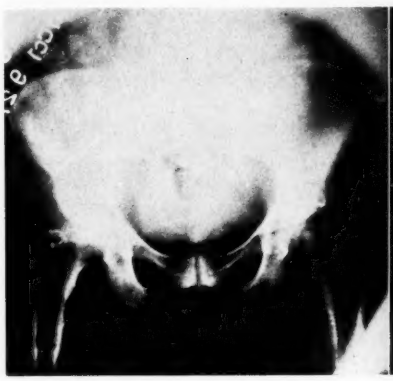

Fig. 13. Case 7. Isolated rarefied areas in pelvis and femora.

Fig. 14. Case 7. Isolated rarefied areas in humeri.

X-ray examination (Sept. 15, 1932) of the chest showed the following: There is greatly increased density in, and increased width of, both hilus areas. There are extensive tuberculous lesions of the fibrotic and productive types in the upper lobes of both lungs. The cardiac shadow appears to be greatly enlarged in the transverse diameter. Several rounded shadows appear in the superior mediastinum. (Fig. 12.) *Sternum:* The body of the sternum is greatly thickened in the anteroposterior diameter, the thickened region being filled in with an osteoid material which extends irregularly downward into the upper abdominal wall region. There is loss in identity between the cortical and medullary regions in the lower part of the sternum. *Left leg:* The soft tissues are increased in density around the left fibula, upper part, the lateral margin of this area being irregular. These findings indicate malignant manifestations in the mediastinum, which, in view of the unusual sternal and left leg pathology, suggest lymphosarcoma.

The Wassermann test was negative. Blood count was as follows: hemoglobin, 65 per cent; red blood cells, 3,240,000; white blood cells, 5,000. Urine showed albumin 3 +; specific gravity, 1.003; red blood, epithelial, and pus cells; Bence-Jones protein absent.

Comment.—This case illustrates the difficulty of differential diagnosis. Roentgenologically the isolated sternal lesion suggested lymphosarcoma, but the microscopic slide demonstrated myeloma, and the soft tissue leg tumor may have been merely a coincidence. We hope to report a biopsy from the leg at a later date.

Case 7. C. F., No. 9,717, housewife, age 52, was admitted to the New York City Cancer Institute, Sept. 26, 1932. She was referred here for post-operative treatment two weeks following a mastectomy for malignancy. Prior to the mastectomy she had noted a slight redness of the right breast, with a lump in it and some swelling

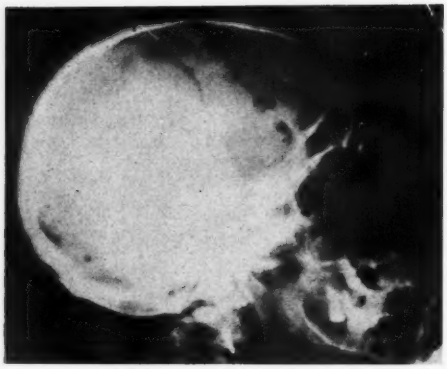

Fig. 15. Case 7. Isolated rarefied areas in skull.

of the right upper extremity: no other symptoms. Physical examination showed a right mastectomy scar and an induration in the whole right mammary region, the right axilla, both clavicular areas, and the posterior right shoulder. The tissues of the right chest and axilla were fixed to the subjacent structures. No axillary nodes were palpated. The rest of the physical examination was negative.

X-ray examination (Sept. 27, 1932) showed (Figs. 13, 14, and 15) a basal pleurisy in the right chest, areas of destruction in the ribs, with pathologic fractures in the right third and seventh ribs posteriorly, and the left fifth rib posteriorly, and localized rarefied areas throughout the skull, iliac bones, femora, humeri, radii, ulnæ, tibiæ, and fibulæ. There was also a compression of the intervertebral disc space between the ninth and tenth thoracic vertebræ and a destructive process in the second lumbar vertebra.

The Wassermann and urine tests were negative. *Blood count:* Hemoglobin, 85 per cent; red blood cells, 4,600,000; white blood cells, 13,000.

High voltage x-ray therapy was administered to the right chest anteriorly and posteriorly and also to the right supraclavicular area (3,000 r).

Comment.—This case clinically has all the earmarks of a post-operative case of cancer of the breast, but the bone lesions roentgenologically assume more the typical appearance of multiple myeloma than of metastatic foci.

CONCLUSIONS

1. Multiple myeloma is still sufficiently rare, although the x-ray has quickened the impetus of diagnosis.
2. Multiple myeloma is insidious in onset, vague in symptomatology, and lacking in physical findings, rendering the x-ray of primary importance in the clinical diagnosis.
3. Differential diagnosis from other similar bone changes is at times very difficult.
4. Trauma may play a rôle in its onset.
5. X-ray treatment aids the clinical symptom of bone pain, when present, and may temporarily retard the progressive bone destruction.
6. Prognosis is still very poor.

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THE CLINICAL VALUE OF PUNCTURE BIOPSIES

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THIS analysis of 68 puncture biopsies is made in an attempt to evaluate the importance of the procedure, its efficiency, advantages, and limitations.

The use of a needle and syringe for aspirating tumor cells in an attempt to simplify biopsy methods and minimize surgical trauma to the tumor is an old procedure which has been popularized and expanded by Martin and Ellis (1) since 1930. Prior to that time, puncture biopsies, with or without suction, had been recommended in specific instances such as brain tumors and large nodes of malignant lymphomas. Martin and Ellis applied aspiration to various tumors with encouraging success, and found no danger of dissemination, for, as they said, "The danger of local or general dissemination through the minute break in the tumor capsule produced by an 18-gauge needle is comparatively slight."

The perfection of puncture biopsy procedures is a progressive step in tumor diagnosis, and has assisted materially in many instances in the selection of proper therapeutic measures. The use of them has obviated in considerable measure the tumor-disseminating incisional biopsy. It has permitted the microscopic study of deep-seated tumors which would otherwise have been treated blindly without histologic diagnosis.

Despite increased proficiency developed by ample experience, several disadvantages became apparent in the aspiration method of biopsy: (1) It was commonly necessary to puncture the tumor from two to twelve times before a few small bits of tissue were extracted, despite the fact that the technic outlined by Martin and Ellis, and later by Ferguson (2), was carefully followed; (2) the percentage of failures was high, particularly in hard, cartilaginous or fibrous tumors; (3) in several instances, these repeated punctures caused hemorrhages into the tissue and unquestionably stimulated the tumor to greater activity; (4) the bits of tissue which were obtained by aspiration were so small that they permitted only a direct smear without adequate fixation or sectioning of the specimen. This specimen usually stained poorly and provided indistinct cell detail

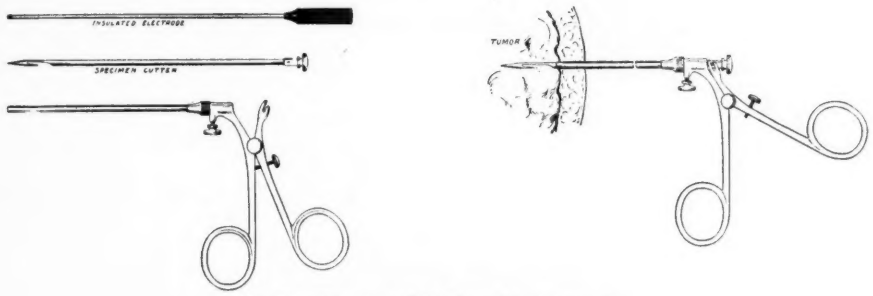

Fig. 1. Diagram of Hoffman biopsy punch.

and tissue structure so that one could determine only the presence or absence of malignancy in the majority of cases. Often it was impossible to make a decision as to the character of the cells obtained, so that the total information provided by the procedure was greatly limited. These smears of disorganized cells required special experience on the part of the pathologist if falsely positive diagnoses were to be avoided or a high degree of diagnostic accuracy maintained.

In January, 1931, Hoffman (3, 4) described his invention of a special biopsy punch. This instrument (Fig. 1) was larger than the 18-gauge aspirating needle, and was made in two sizes: 2 mm. and 3 mm. in diameter. However, this defect of larger size was compensated for by the fact that only a single puncture was necessary to obtain a piece of tissue at each attempt. Furthermore, the specimen removed was always large enough to permit not only the making of a direct smear, but also of a paraffin section. Thus, cell detail and tissue architecture, which are so important in diagnosing and classifying malignant tumors, were preserved, and no special skill or training on the part of the pathologist was required in the interpretation.

For these reasons, the aspirating needle was discarded in favor of the Hoffman punch. The biopsies reported in this series have all been taken with the latter instrument.

DISADVANTAGES OF ALL METHODS OF PUNCTURE BIOPSY

1. *The Nature of the Tumor.*—Large nodes containing metastatic squamous carcinoma are prone to undergo necrosis or secondary infection. The puncturing needle thus obtains a semi-fluid material composed of liquefied, degenerated cells, or cells obscured by inflammatory transudate which may reveal no definite evidence of malignancy under the microscope. In the case of small nodes, it is very difficult to place the point of the needle or punch within the node in such a way as to obtain tumor cells, and one is often disap-

COMPARISON OF ASPIRATION BIOPSY WITH HOFFMAN PUNCH BIOPSY

Aspirating Needle	*Hoffman Biopsy Punch*
Its small diameter (18 gauge), 1 mm., causes little trauma during a single introduction but the total trauma of multiple punctures may be considerable.	Larger diameter (2 mm. and 3 mm.) produces more trauma during its introduction but usually only a single puncture is required.
Obtains only a few minute fragments of tissue or clumps of cells which permit only a direct smear; rarely, a paraffin section.	A larger, solid piece of unchanged tissue is obtained, sufficient to permit the making of a smear and a paraffin section in every case.
Can be used safely in the vicinity of important structures such as the carotid arteries, vagus nerve, or in the lung, liver, or spleen.	Must be used with caution in the vicinity of important structures. Should not be employed in the thorax or abdomen.
Cannot be depended upon to obtain a specimen from the wall of a cyst.	Specimen easily obtained from the wall of a cyst.
Smear often fails to reveal good cell detail. Tissue architecture usually impossible to recognize.	Paraffin section provides excellent cell detail and tissue architecture.
Special experience on the part of the pathologist required to interpret the smears.	No special experience necessary to diagnose the paraffin sections of a punch biopsy.
Information obtained from smear usually limited to a diagnosis of malignancy or benignancy, although tumors composed of special cell types may be recognized on smear (giant-cell tumors, squamous carcinoma, etc.).	Accurate diagnosis and pathologic classification of tumor usually easy.
Diagnostic efficiency is lower than with the biopsy punch, particularly in firm, fibrous, or cartilaginous tumors.	Diagnostic efficiency high in all types of tumor into which the instrument is introduced.
Falsely positive diagnoses occasionally are made.	No falsely positive diagnoses.

pointed to discover that the piece of tissue removed consists of strands of fibrous tissue or overlying muscle.

2. *Traumatic Aggravation of the Tumor.*—We have seen several instances in which the injury inflicted by the examining needle has produced an immediate swelling of the tumor due to hemorrhage or to rupture of a capsule which has been under tension. This swelling subsided partially and then enlarged more rapidly than before. Doubtless, in these instances the diagnostic needle produced definite injury. These injuries, however, are by no means as severe and dangerous as those produced during the course of a surgical biopsy.

3. *Significance of a Negative Puncture Biopsy.*—A negative puncture biopsy has little significance. The failure to obtain malignant tissue by either method does not rule out its presence. Where the clinical setting suggests malignancy, the biopsy should be repeated.

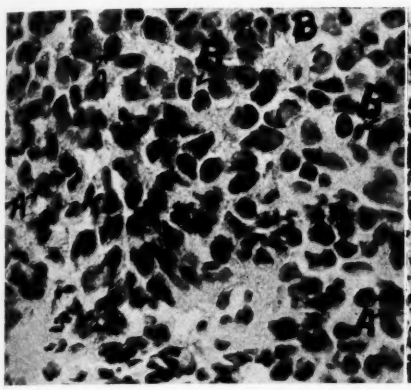

Fig. 2. Case 4. Chondroblastic osteogenic sarcoma of the sacro-iliac joint. (*A*) Large, somewhat indistinct nuclei of the young chondroblast, in the stage before the formation of the hyaline matrix. (*B*) The more adult, though not yet fully formed, multinucleated cartilage cell, with the hyaline matrix. This is the only radiosensitive type of osteogenic sarcoma, and an exact diagnosis is necessary for proper treatment.

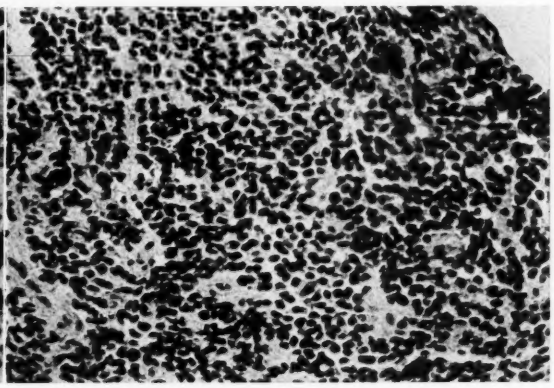

Fig. 3. Case 2. Endothelial myeloma of scapula. Characteristic, small, polyhedral cells with round and oval nuclei. Diagnosis confirmed by rapid response of tumor to radiation.

BONE TUMORS

In the diagnosis of bone tumors, the Hoffman biopsy punch finds its greatest field of usefulness (see Fig. 2). Because the roentgen evidence is so frequently inconclusive, the diagnosis of a bone tumor is often in doubt. These tumors vary so widely in their clinical course, prognosis, and radiosensitivity, and their treatment may require either the sacrifice of a limb or the relatively simply procedure of curettage and chemical cautery, or irradiation, that a positive diagnosis is absolutely essential. In a group of 17 bone tumors in which punch biopsy was attempted, only once did the instrument fail to provide tissue for diagnosis. This so-called failure was due to the fact that the tumor was a central giant-cell tumor of the ischium, surrounded by a solid bony shell which could not be penetrated by the instrument. As a matter of fact, this difficulty should have been anticipated from the roentgenogram, and the punch biopsy never attempted. Another bone lesion which may yield an unsatisfactory biopsy specimen is sclerosing osteogenic sarcoma. In this type of tumor, in which there is little or no erosion of the cortex,

it may be found impossible to introduce the punch, and consequently the specimen of tissue obtained may reveal only newly formed reactive bone containing no malignant cells. Cases 8 and 13 were examples of this, and failed to reveal abnormal tissue.

In this group of bone tumors, there were 14 positive results out of 17 attempts (81 per cent). In Case 6, the diagnosis rested between osteogenic sarcoma and osteomyelitis. The punch biopsy revealed inflammatory tissue. The diagnosis was confirmed at a subsequent operation.

Occasionally it is impossible to make an exact histologic diagnosis of a very cellular malignant bone tumor, and one must rely upon the response to radiation therapy to differentiate between a cellular osteolytic osteogenic sarcoma and an endothelial myeloma (Case 2). (See Fig. 3.)

It is difficult to obtain tissue from a cystic tumor of the mandible because of the usual surrounding impenetrable bony shell, or because the tough masseter muscle deludes one into mistaking it for tumor tissue, and the operator therefore fails to in-

TABLE I.—BONE TUMORS

No.	Clinical Diagnosis	Location	Histology	Result of Biopsy
1	Osteogenic sarcoma	Upper humerus	Chondromyxosarcoma	+
2	Osteogenic sarcoma	Acromial process	Endothelial myeloma	+
3	Fibrocystic disease	Ilium	Chondroma	+
4	Sarcoma	Sacro-iliac joint	Chondroblastic osteogenic sarcoma	+
5	Giant-cell tumor	Ischium		−
6	Osteomyelitis	Astragalus	Inflammatory tissue	+
7	Malignant bone tumor	Ilium	Cellular, undifferentiated malignant tumor	+
8	Malignant tumor in bone	Sacrum	Fibrous connective tissue	−
9	Osteogenic sarcoma	Femur	Fibrous inflammatory tissue	+
10	Chondroma	Pubis	Cartilage cells	+
12	Fibrocystic disease	Mandible	Fibrous tissue	+
13	Osteogenic sarcoma	Upper femur	Fibrous tissue and possibly bone cells	−
14	Osteogenic sarcoma	Sacrum	Cellular malignant tumor	+
15	Cyst of mandible	Mandible	Chronic inflammatory tissue	+
16	Osteogenic sarcoma	Lower femur	Malignant cellular tissue with incomplete cartilage and bone formation	+
17	Osteogenic sarcoma	Pubis	Endothelial myeloma	+

Fourteen positive results out of 17 (82 per cent).

TABLE II.—METASTATIC CARCINOMA OF BONE

No.	Clinical Diagnosis	Location	Histology	Result of Biopsy
18	Primary or metastatic tumor	Ilium	Metastatic carcinoma	+
19	Metastatic carcinoma of thyroid	Ilium	Papillary adenoma of thyroid	+
20	Tumor	Sacro-iliac region	Transitional cell epithelioma	+
21	Generalized malignancy	Mandible		−
22	Metastatic carcinoma of thyroid	Rib	Anaplastic carcinoma	+
23	Metastatic carcinoma	Ischium	Papillary adenocarcinoma (uterus or ovary)	+
24	Osteogenic sarcoma	First rib	Metastatic epithelioma	+
25	Carcinoma of cervix with bone metastasis	Sacrum	Plexiform epithelioma	+

Seven positive results out of eight biopsies (87 per cent).

troduce the instrument into the affected area.

METASTATIC TUMORS OF BONE

This is a miscellaneous group of bone tumors. Some of them were originally considered primary tumors of bone, and some were thought to be metastatic tumors of undetermined origin. In seven out of eight cases the punch biopsy revealed not only the true nature of the tumor, but also the probable source of origin of some (Fig. 4). In situations of this kind, the positive diagnosis of metastatic carcinoma provided by the punch biopsy may preserve the patient from a futile and mutilating amputation.

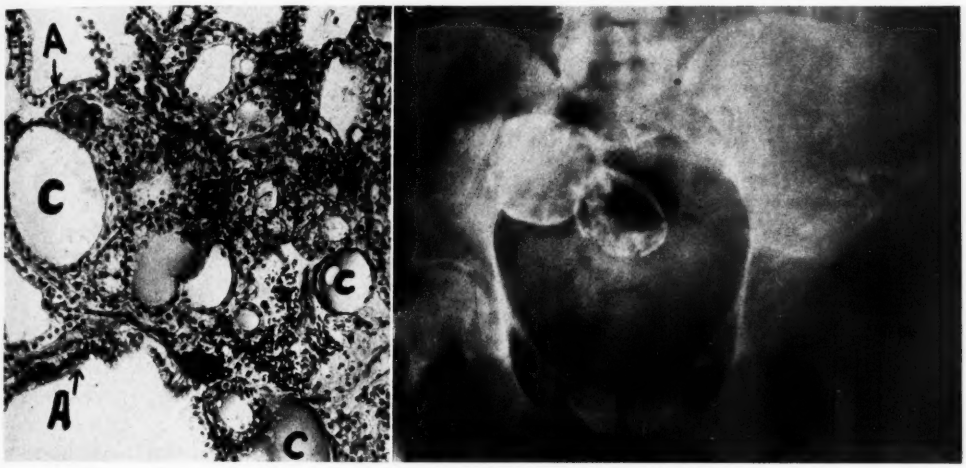

Fig. 4. Case 19. Metastasizing papillary adenoma of the thyroid gland. Puncture biopsy taken from mass in the right ilium. Roentgenographic diagnosis was malignant cystic tumor of bone. The calcified fibroids were incidental. Normal appearing, flat, columnar cells (*A*) lining the alveoli, and acini filled with colloid (*C*) are characteristically benign. The cellularity of the stroma (*B*) is only faintly suggestive of malignancy.

Fig. 5. Case 23. Papillary adenocarcinoma of the fundus uteri metastasizing to the ischium. Mass in ischium was the first clinical sign, and resembled roentgenographically a giant-cell tumor. Needle punch biopsy revealed (*P*) papillary stalks consisting of solid and cystic masses of cells mounted on a ramifying connective tissue base (*S*). Numerous areas of alveolus formation (*C*).

Case 23 (Fig. 5), an adenocarcinoma of the fundus uteri, first manifested itself as an osteolytic process of the ischium. A punch biopsy of this tumor revealed a papillary adenocarcinoma, whose source was thought to have been the uterus or ovary. Though there were no symptoms

referable to the pelvis, a gynecologic examination was made and the uterus found to be slightly enlarged. A curettage showed the presence of papillary adenocarcinoma of the fundus on subsequent histologic examination. In another instance, Case 24, a tumor diagnosed as a primary osteolytic osteogenic sarcoma of the first rib was shown to be a deposit of metastatic carcinoma.

TABLE III.—TUMORS OF THE BREAST

No.	Clinical Diagnosis	Location	Histology	Result of Biopsy
26	Primary operable carcinoma of breast	Breast	Anaplastic carcinoma	+
27	Primary inoperable carcinoma	Breast	Medullary carcinoma	+
28	Primary advanced carcinoma	Breast	Medullary carcinoma	+
29	Primary inoperable carcinoma	Breast	Anaplastic carcinoma	+
30	Primary operable carcinoma	Breast	No malignancy	−
31	Primary operable carcinoma	Breast	No malignancy	−
32	Primary operable carcinoma	Breast	No malignancy	−
33	Primary operable carcinoma	Breast	Fibroadenoma	+
34	Chronic mastitis	Breast	Compressed normal glands	+
35	Lipoma	Breast	Fatty tissue	+
36	Recurrent carcinoma of breast	Chest wall	Medullary carcinoma	+
37	Recurrent carcinoma of breast	Supraclavicular node	Metastatic carcinoma	+
38	Recurrent carcinoma of breast	Chest wall	Medullary carcinoma	+
39	Recurrent carcinoma of breast	Chest wall	Small group of malignant cells	+

Eleven positive results out of fourteen attempts (78 per cent).

TABLE IV.—CERVICAL NODES

No.	Clinical Diagnosis	Location	Histology	Result of Biopsy
40	Malignant lymphoma	Upper neck	Normal salivary gland	−
41	Neck node, undetermined origin	Lower neck	Cellular fibrous tissue	−
42	Metastatic basal cell carcinoma of skin	Posterior neck	Metastatic basal-cell carcinoma	+
43	Tuberculous neck nodes	Hyoid node	Myositis	−
44	Benign neck node	Angle of jaw	Benign chronic lymphoma	+
45	Metastatic carcinoma of lung	Lower triangle of neck	Metastatic bronchogenic carcinoma	+
46	Neck node, undetermined origin	Lower neck	Fibrous tissue	+
47	Metastatic carcinoma from mouth	Lower neck	Few suspicious malignant cells	+
48	Carcinoma of larynx	Posterior triangle	Squamous-cell epithelioma	+
49	Carcinoma of lung	Supraclavicular triangle		−
50	Carcinoma of lung	Lower neck	Metastatic epithelioma	+
51	Neck node, undetermined origin	Lower neck	Epidermoid carcinoma, Grade 3	+
52	Malignant lymphoma	Angle of jaw	Simple lymph node	−
53	Mediastinal tumor	Lower neck	Anaplastic carcinoma	+

Nine positive results out of fourteen attempts (64 per cent).

TUMORS OF THE BREAST

In tumors of the breast, punch biopsy should not replace the frozen section examination of the piece of tissue removed while the patient is on the operating table. A certain group of patients, however, will refuse to permit an operative biopsy in a tumor whose clinical appearance is not alarming, and will insist upon delay until the tumor has given unmistakable evidence of its malignant character. These patients usually will not refuse to permit a punch biopsy which can be performed in the physician's office at the time of the first examination. Thus the most important and dangerous element in the treatment of cancer, namely, delay, is eliminated.

Punch biopsies of breast tumors are indicated in advanced, inoperable carcinomas, in cases in which final confirmation is desired for corroboration of the clinical diagnosis, and for an estimation of the radiosensitivity of the tumor as a guide in determining the type of radiotherapy most desirable.

Following radical mastectomy, it is often difficult to differentiate between a local recurrence and a muscle stump. Punch biopsy in these cases constitutes a valuable aid.

In a primary breast carcinoma, should the punch biopsy fail to reveal any evidence of cancer, and the clinical setting not be clearly characteristic of a benign tumor, one should not assume the absence of cancer but promptly perform a surgical biopsy. Cases 30, 31, and 32 illustrate this point. The punch biopsies were negative, but frozen section examinations revealed the presence of cancer.

Repeated punch biopsies, or multiple punctures to obtain numerous specimens from different areas are contra-indicated in vascular or rapidly growing breast tumors. The excessive trauma in two of the above cases was followed by enlargement of the tumor.

Of the 14 primary and recurrent breast tumors in this series, 11 punch biopsies (78 per cent) yielded positive diagnoses.

CERVICAL NODES

In the group of cervical lymph node enlargements, punch biopsies registered the largest percentage of failures. This was due to many reasons. Frequently the nodes were small, and the punch obtained either a part of the capsule or the overlying muscle. The proximity of so many vital structures deterred the operator from inserting the needle deeply enough in some instances. Many of the larger nodes had undergone central necrosis, and examination of this material revealed the shadowy outlines of cells suspiciously resembling carcinoma but not definitely diagnostic. These failures in diagnosis are attributable to the character of the material rather than the instrument used. Because of the reluctance to diagnose cancer on such degenerated material, and because of the probability of missing a small malignant deposit in a node, the value of a negative biopsy here is questionable.

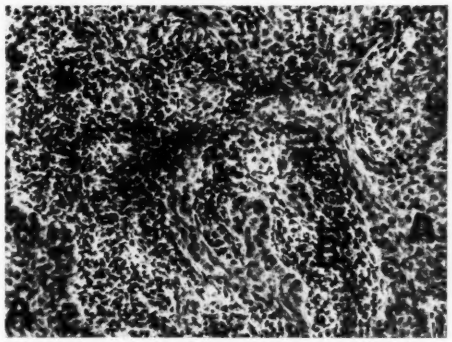

Fig. 6. Case 42. Metastasizing basal-cell epithelioma. Primary lesion was a rodent ulcer of the temple about 2 cm. in diameter. The above photomicrograph is that of the needle punch biopsy taken from the enlarged submaxillary node on the same side. (*A*) Characteristic basal arrangement of the carcinoma cells. (*B*) Stroma with considerable lymphocytic infiltration.

The microscopic diagnosis of Hodgkin's disease is difficult to make under the best of conditions. It is usually necessary to examine large areas of tissue before finding characteristic cells or architecture. While the biopsy punch always obtains tissue, the amount is frequently insufficient to exhibit all the cellular elements, such as Dorothy Reed cells, reticular hyperplasia, and eosinophilic cells, which form the basis of the histologic diagnosis of Hodgkin's disease. In the presence of multiple small cervical or general lymphadenopathy, it is wiser to excise a whole node for microscopic examination.

In this group of 14 cases, there were five failures (64 per cent positive results). (Fig. 6.) Two of these failures exhibited groups of cells which, though suggestive, could not positively be identified as malignant cells.

MISCELLANEOUS GROUP

In this group, comprising tumors of the thyroid and prostate glands, lymphosarcoma, sarcoma of the soft tissues, etc., the punch biopsy assisted remarkably in their diagnosis. (Figs. 7 and 8.)

Tumors of the lung tempt one to use the biopsy punch, but the profusion of large vessels and bronchioles, which might easily be punctured, limits such a method to peripheral and apical new-growths. In this type of tumor, aspiration is safer and yields some positive results. In one of our cases (Case 61), we attempted a punch biopsy of a deep-seated lung tumor. The growth was missed, but a small piece of easily recognizable normal lung tissue was removed without complication. In sarcomas of muscle, fascia, and tendon sheaths, punch biopsy provides valuable results. In this series, there were nine successful biopsies in fourteen attempts (64 per cent).

Fig. 7. Case 56. Spindle-cell fibrosarcoma of the thigh. (*S*) Characteristic spindle cells with little stroma, adult in type. (*C*) Capillaries, lined with adult endothelium. In spite of this adult picture, the tumor was moderately radiosensitive.

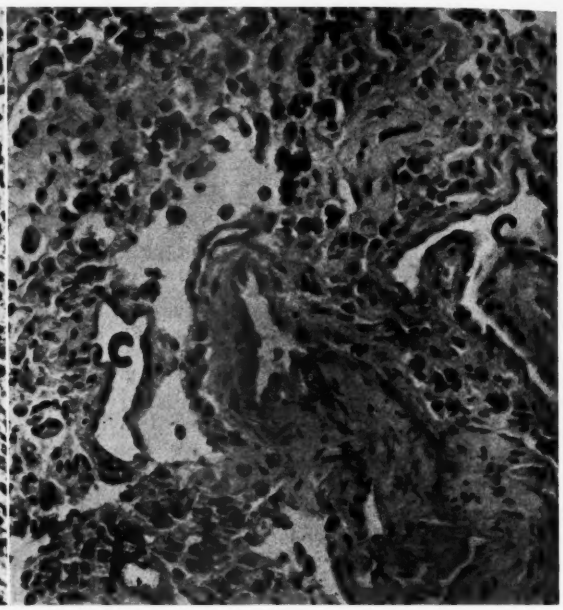

Fig. 8. Case 60. Perithelioma of the skin of the leg. Punch biopsy taken from a metastatic nodule in the supraclavicular area. (*C*) Capillaries: (*P*) Large, acidophilic tumor cells.

ELECTROCOAGULATION

The Hoffman biopsy punch is provided with a coagulating electrode, which is inserted through the cannula after the tissue has been removed. By this means, the opening in the tumor and needle tract are coagulated in order to arrest any bleeding and prevent dissemination. The practical value of this part of the technic in preventing dissemination is difficult to estimate. As far as the control of bleeding is concerned, capillary oozing may be controlled by simple pressure, while profuse bleeding could never be controlled with this single electrode.

PREPARATION OF THE SPECIMEN

Care in the handling of the specimen so as not to lose the cellular portion attached to the tough fibrous stroma, and also the subsequent preparation of the microscopic slide are of paramount importance. Some of our earlier failures could be attributed to this omission, others to improper fixation and staining of the section.

We employ only paraffin sections which require forty-eight hours to complete. In urgent cases, these sections can be prepared in three hours. The immediate smear and staining method destroys tissue architecture so that the specific type of tumor can only occasionally be recognized.

TABLE V.— MISCELLANEOUS TUMORS

No.	Clinical Diagnosis	Location	Histology	Result of Biopsy
54	Fibrosarcoma of leg	Calf of leg	Mixed spindle- and giant-cell sarcoma	+
55	Fibrosarcoma of thigh	Mid-thigh	Fibromyxosarcoma	+
56	Fibrosarcoma of thigh	Mid-thigh	Spindle-cell sarcoma	+
57	Adenoma of thyroid	Thyroid gland	Indistinct glandular tissue	+
58	Recurrent tumor of thyroid	Thyroid gland	Anaplastic carcinoma	+
59	Malignant lymphoma	Axillary node	Lymphosarcoma	+
60	Metastatic perithelioma	Shoulder	Perithelioma	+
61	Lung tumor	Lung	Cellular fibrous tissue	−
62	Benign tumor	Pre-parotid area	Muscle tissue	−
63	Possible carcinoma of prostate	Prostate	Normal prostate	+
64	Possible carcinoma of prostate	Prostate	Normal prostate	+
65	Carcinoma of lung	Lung	Normal lung tissue	+
66	Cervical adenitis	Neck node	Parotid tumor	+
67	Lymphosarcoma	Skin nodule	Lymphosarcoma	+
68	Lymphatic leukemia	Inguinal node	Lymph node with sinuses filled with lymphocytes	+

Thirteen positive results out of fifteen attempts (86 per cent).

CONCLUSIONS

1. Puncture biopsy is a valuable aid in providing a diagnosis of a suspected tumor. It may obviate an operative procedure with its severe traumatic dissemination of tumor cells.

2. The Hoffman biopsy punch and technic is superior to the aspirating needle.

3. This biopsy punch is particularly valuable in the diagnosis of tumors of the breast and bones. It has a high percentage of diagnostic efficiency in tumors of all types and consistencies.

4. Punch biopsy, however, should not replace the formal surgical biopsy of tumors of the breast made in the operating room with preparation for a radical mastectomy if the specimen proves to be malignant. In those cases in which the patient will not permit a surgical biopsy the Hoffman punch affords an easy method of diagnosis which the average patient will accept.

5. In a case of suspected Hodgkin's disease the excision of a node is preferable to a punch biopsy in order to provide enough tissue for a careful and patient search for the diagnostic features of this disease.

6. In this series of 68 attempts, 54, or 80 per cent, of the punch biopsies were successful in providing correct histologic information. No false positive diagnoses were made.

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PROCESSING X-RAY FILMS AT HIGH TEMPERATURES

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THE processing of films in summer months and in tropical climates offers many difficult problems and often taxes almost to the limit the ingenuity as well as the nerves of the dark-room technician. There is scarcely an x-ray laboratory that is not familiar with the peeled, scratched, crinkled emulsion peculiar to high temperatures. These obstacles offered by heat are all too often dismissed as insurmountable and wretchedly macerated emulsions accepted with a Job-like attitude. Photographers, especially those in Government service, have found means of combating the effects of heat and with little trouble these measures can be applied to any x-ray processing room, whether it be a 4 × 4 foot closet in a private office or a large refrigerated hospital dark room (and both types suffer from the heat). By the use of some very simple measures available to any one, it is not only possible but quite easy to finish x-ray films at temperatures up to 95 degrees F. without any cooling of the solutions, yielding results comparable to any that could be obtained under ideal conditions.

Fig. 1. Control film, processed in refrigerated tanks at 65 degrees F. with EKC prepared chemicals.

The accompanying illustrations show what can be done at higher temperatures. Figures 1 and 2 are identical exposures of the same patient on Eastman safety film. Figure 1 was finished by our regular technician in refrigerated tanks at 65 degrees F. with Eastman prepared chemicals. Figure 2 was finished by the sulphate-formalin process, to be outlined here, at room temperature of 89 degrees F. Figure 3 shows what normally happens when a film is processed in too warm solutions without some special procedure. I have been more or less seriously interested in photography for some twelve years and have tried many recommended means of combating heat, an even more serious problem to the photographer than to the radiologist. The method presented here has been used by me in photography for several summers, and much longer by countless other photographers, with excellent results. It has been tried in our laboratory here during the Summer of 1934 and found to be quite practical for x-ray purposes. We have run duplicate exposures, of which Figures 1 and 2 are examples, using one as a control by running it through the routine refrigerated tanks and processing the other at temperatures ranging from 70 degrees F. to 95 degrees F. The films were then reviewed at our regular film-reading conferences. Those finished at higher temperatures were found not to be inferior to the controls in any respect—detail, contrast, fog,

or diagnostic value—and the emulsions were preserved perfectly.

In order to deal intelligently with the situation brought about by summer heat, it is necessary to understand something of the chemistry and physics involved. An x-ray film consists of a sheet of celluloid, coated on both sides with gelatin in which the sensitive salts are embedded. Development consists of the reduction to metallic silver of those salts which have been acted on by the rays, by means of the reducing action of the developing agents in alkaline solution. Fixation is the removal of the unreduced silver salts by the action of sodium thiosulphite (hypo), usually employed in acid solution. Washing is merely to remove the chemicals absorbed in the processing. Gelatin is a colloid and, when wet, absorbs water, swells, and becomes soft and spongy. This phenomenon takes place in degree and rapidity proportionate to the temperature, and inversely proportionate to the osmotic pressure (salt content) of the solution. At and below 65 degrees F., swelling of the gelatin is almost negligible, but for some reason, changing a film to a bath of higher or lower temperature seems to do much more damage than keeping the film at a higher temperature from the first. When the emulsion is in this boggy, swollen state, it is very easily stripped off by a chance contact with even a finger and occasionally slips on its celluloid mount of its own accord.

At first thought, the obvious answer to this problem is *ice*. Cooling of solutions is of untold value, but any one who has ever tried to work in an ice-packed tray will agree that it is far from ideal. For one thing, all the solutions, *including the wash water*, must be kept within a few degrees of the same temperature, or very little will have been accomplished. An electrically refrigerated tank system is, of course, infinitely more convenient and efficient but by no means perfect. Remember, the film has to be taken out to dry, and sometimes has to be taken out for emergency interpretation (the Number One enemy of a boggy emulsion), and as soon as the warm air strikes the surface coat of water, the gelatin swells and swells rapidly. Few laboratories have installed a refrigerated drying box. Drying before fans helps, and emersion in 95 per cent ethyl alcohol after washing speeds the drying and helps still more. Incidentally, removal of excess water by swabbing the washed film with the new "Viscose Sponge," obtainable from any photographic supply house, gives quicker and more even drying and will not damage the emulsion. But all of these extra steps and the added equipment take time and increase the operating expense to no small degree.

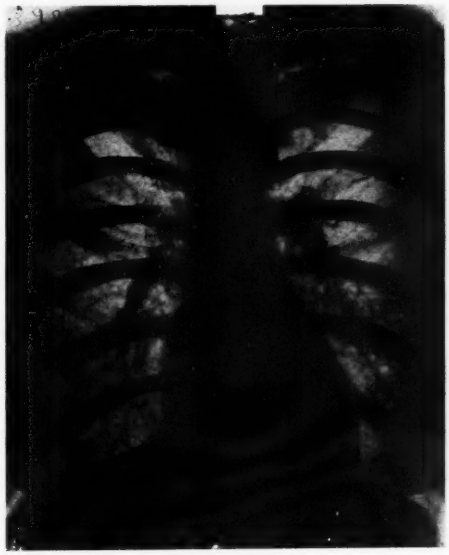

Fig. 2. Film processed at 89 degrees F. by the sulphate-formalin method. Same patient; identical exposure with Figure 1.

Fortunately, there is a much more practical and inexpensive salvation. Gelatin may be hardened or "tanned" quite easily. Formalin possesses unlimited power of hardening the emulsion; in fact, a film treated sufficiently with formalin may be subjected to boiling water without damage. The ideal would seem, then, to bathe the film in formalin as the first step

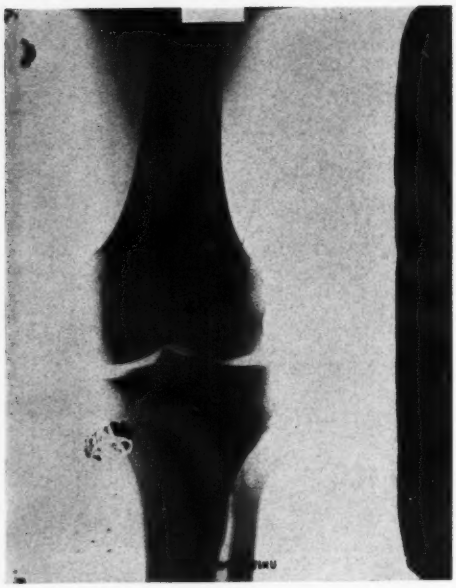

Fig. 3. Showing the effects of heat on a film processed by usual methods at higher temperatures.

in processing, but this causes so much chemical fog as to be impractical. And, by the time development has been completed at a temperature of 70 degrees F. or above, the damage has been done and the coating too boggy to be "tanned." Something must be done at the very onset of immersion of the film in solution. If we are able to carry the emulsion through development without appreciable change, we may then use formalin without fear of fog.

As was pointed out above, swelling takes place inversely proportionate to the osmotic pressure of the solution. The addition of any salt in high concentration in the solution tends to inhibit this occurrence. Most salts influence the action of the developer or cause chemical fog, but there is one readily available compound, sodium sul*phate*, which does neither and is very effective in preventing swelling.

The following formula (Eastman D19a, plus sulphate) is quite satisfactory for hot weather use:

	Avoirdupois	Metric
Water, about 130 degrees F.	2 quarts	2000 c.c.
Elon	128 grains	8.8 gm.
*Sodium sulphite, desiccated	12 oz., 300 gr.	300.0 gm.
Hydroquinone	1 oz., 60 gr.	34.4 gm.
*Sodium carbonate, desiccated	6 oz.	180.0 gm.
Sodium sulphate	13 oz.	390.0 gm.
Potassium bromide	300 gr.	20.0 gm.
Cold water, q. s. ad	1 gallon	4000 c.c.

* If crystals are used, twice the amount will be required. Dissolve chemicals in the order given.

If one prefers to use prepared developer powders, all that is necessary is that 13 ounces of sodium sulphate be added to each gallon of the solution in its final dilution for use. No exact timetable can be given, but, for the above formula, development should be complete at

65 degrees F. in 9 minutes
75 degrees F. in 4 minutes
80 degrees F. in 3 minutes
85 degrees F. in 2 minutes
90 degrees F. in 1½ minutes

This table of development time is fairly accurate for any developer that would normally develop a film in five minutes at 65 degrees F. without the added sulphate. The sodium sulphate almost doubles the time required for development; with the average developer alone, the time of development at 85 degrees F., or above, would be inconveniently short. Development in a sodium sulphate developer leaves the emulsion in a comparatively unswollen state, as can be detected readily by rubbing the film with the fingers. Remember, however, that sodium sulphate protects the emulsion *only so long as it is in contact with the emulsion* and has nothing whatsoever to do with what happens to it later. Its action is purely to prevent swelling by raising the osmotic pressure of the developing solution, nothing more.

We now have our film developed, free from fog and damage to the emulsion. Formalin can now be used to tan the gelatin and insure it against future damage. Since the action of formalin requires several minutes, the most satisfactory method of employing it is to mix it in the hypo-fixing bath. An acidifier must not be

added to the fixing bath if formalin is to be used with it. The function of the acidifier is merely to prevent the alkali carried over from the developer from causing yellow stains on the film, and it may be replaced satisfactorily by an acid bath before placing the film in the neutral fixing solution. Such an acid short stop may be prepared by dissolving 13 ounces of sodium sulphate in a gallon of water, and adding 12 ounces of 28 per cent acetic acid. The films should be bathed in this solution for about thirty seconds before fixation and after development. Rinse in water rapidly before and after, using the short stop.

A suitable formalin fixing bath is given in the following formula:

	Avoirdupois	Metric
Sodium hyposulphite (hypo)	2 lb.	960 gm.
*Sodium sulphite, desiccated	6 oz.	180 gm.
Formalin (commercial, 40%)	16 oz.	500 c.c.
Water, q. s. ad.....	1 gallon	4000 c.c.

* If crystals are used, double the amount will be required. Dissolve the chemicals in the order given.

This combined fixing and hardening bath will keep in good condition for about two weeks. It is advisable to keep it well corked when not in use, as the formalin evaporates very rapidly.

If prepared fixing baths are preferred, simply discard the small container marked "acidifier" and dissolve the contents of the larger package in the specified amount of water to which is added the formalin, 16 ounces to the gallon of fixing bath.

Fix in one of the above baths for the normal time, about one and a half times the length of time required for the film to clear. By this time, the emulsion will be thoroughly hardened and with normal care the film may be handled without damage. Washing should be carried out as usual, in water as near the temperature of the processing solutions as is practical, although the temperature of the wash water is not so important after treatment with formalin. Dried in a dust-free room, the emulsion will be as smooth and the film as perfect as one processed under ideal conditions.

Where a refrigerated tank is used and temperature can be maintained constantly at lower levels, the sodium sulphate developer is not necessary, because, at the ideal temperature of about 65 degrees F., very little swelling of the emulsion takes place. Indeed, it would be undesirable to add sulphate to a developer to be used at lower temperatures because of the tendency it possesses to prolong developer time, a very desirable feature at higher temperatures where the time would be otherwise too short. However, replacement of the usual acid fixing bath by the acid short stop and neutral formalin fixing baths mentioned above will eliminate most of the emulsion hazard of wet-plate reading, and drying in warm air.

SUMMARY

A few important points might be mentioned in conclusion.

It cannot be stressed enough that the vital point about temperature in processing is not that it be low, *but that it be constant.* All baths, including wash water, should be within a few degrees of the same temperature.

Sodium sulphate preserves the emulsion only so long as it is in contact with it, the action being purely a temporary physiochemical one.

Formalin, the perfect hardener, cannot be used before or during development on account of the tendency to produce chemical fog. It cannot be added to an acid fixing bath as it causes a heavy white precipitate.

When a neutral fixing bath is employed an acid short stop must be placed between the fixing bath and the developer or yellow stains will appear on the film. If they do occur, leave the film in the short stop longer, renew the short stop, or add more acetic acid.

Formalin evaporates, so, if proper hardening does not take place, add more formalin to the fixing bath or renew the entire bath.

Generalized brownish-yellow stains on the films may be caused by iron salts in

the water with which the solutions are prepared, or by iron dissolved out from cracks in the enamel of trays, regardless of the developing solutions employed. This iron staining does tend to occur a little more readily at higher temperatures.

Formalin possesses a pungent odor and is rather irritating to the mucous membranes but it is not considered harmful. Pathologists work constantly in much higher concentrations than are recommended here. If used in tanks, the odor is hardly noticeable and those who use trays seldom do a large enough volume of work at one time to find this feature very undesirable.

SUMMARY

A method is presented for the processing of x-ray films at high temperatures without the necessity of cooling the solutions. Films processed at temperatures up to 95 degrees F. by this method are in no way inferior to those processed at the ideal temperature of 65 degrees F.

I wish to express my appreciation for the assistance received from the Eastman Kodak Company, and especially from their representative, Mr. Charles W. Smith.

THE EFFECT OF ROENTGEN IRRADIATION OF THE ENTIRE ANIMAL ON THE PHOSPHATASE ACTIVITY AND ELECTROLYTE CONTENT OF ITS WATER EXTRACT[1]

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IT was found in a previous study (1) that exposure of growing dog bone to moderate doses of roentgen rays is followed by a period of lowered phosphatase activity beginning a few days after exposure and showing a tendency to return to normal after from three to five weeks. Since the enzyme phosphatase is so widely distributed in the animal body it was felt that a study of the phosphatase activity of the entire body after exposure to x-rays would be of interest. Also, we desired to determine the concentration of certain electrolytes, some of which are known to influence the activity of the enzyme. Loiseleur and Van der Schueren (2) and Adler and Wiederhold (3) have studied the metabolism of several inorganic substances in the rabbit following x-ray irradiation. Kinard and Chanutin (4) found that the phosphatase activity of the whole rat was increased following large doses of irradiated ergosterol.

Analytical Methods.—The phosphatase determinations were made by a technic similar to that described by Jenner and Kay (5) for plasma phosphatase. Chlorides were estimated by the method of Van Slyke and Sendroy (6). The other inorganic substances were determined by methods adapted to this type of work by Cullen and Wilkins (7).

Procedure.—Two litters of New Zealand white rabbits, 25 and 31 days of age, respectively, were used. Each litter was divided into two groups: one group of each was subjected to deep x-ray therapy (550 to 1,100 roentgens) over the entire body, the other group being used for controls. The factors constituting the dose of x-ray were 190 to 200 kilovolts, 20 milliamperes, 50 cm. target-skin distance, filter of 0.25 mm. Cu, and 10 to 20 minutes' exposure.

One week after treatment the animals were killed by a blow over the neck. Each entire animal was ground three times through a meat chopper and the resulting material was transferred quantitatively to a large glass bottle. Ten parts (by weight) of distilled water and a few cubic centimeters of chloroform were added, and the tissue was extracted at room temperature for from 36 to 48 hours with occasional vigorous shaking. At the end of the extraction period and after a final thorough shaking, a portion (300–500 c.c.) of each extract was centrifuged and filtered through coarse filter paper. The various determinations were made on this filtrate. All analyses were made at least in duplicate, beginning with the original extract. The ages, weights, dose of x-ray, and time of extraction are shown in Table I.

Results.—The resulting values, except for phosphatase activity, fell within a very narrow range. The average values for phosphatase activity, total phosphorus, inorganic phosphorus, chlorides, calcium, magnesium, sodium, and potassium are given in column graphs in Figure 1. Except for phosphatase, the concentrations are given in milligrams per 100 c.c. (which represents the material extracted from 10 gm. of tissue). The phosphatase activity is expressed in milligrams of inorganic phosphorus liberated in one hour at 38° C. from a substrate of sodium B-glycerophosphate (maintained at PH 8.8 by a NaOH-glycine buffer mixture) by the enzyme in 100 c.c. of extract.

The phosphatase activity of the irradiated animals showed a definite decrease as compared with the controls. This difference, while not as marked as we had previ-

[1] Received for publication July 19, 1934.
The expense of this investigation was aided by the Fluid Research Fund.

ously found in growing dog bone, was significant, since within a given litter the highest phosphatase activity among the

decrease *in vivo* as indicated in the *in vitro* assays. At best, evidence of this nature is indirect.

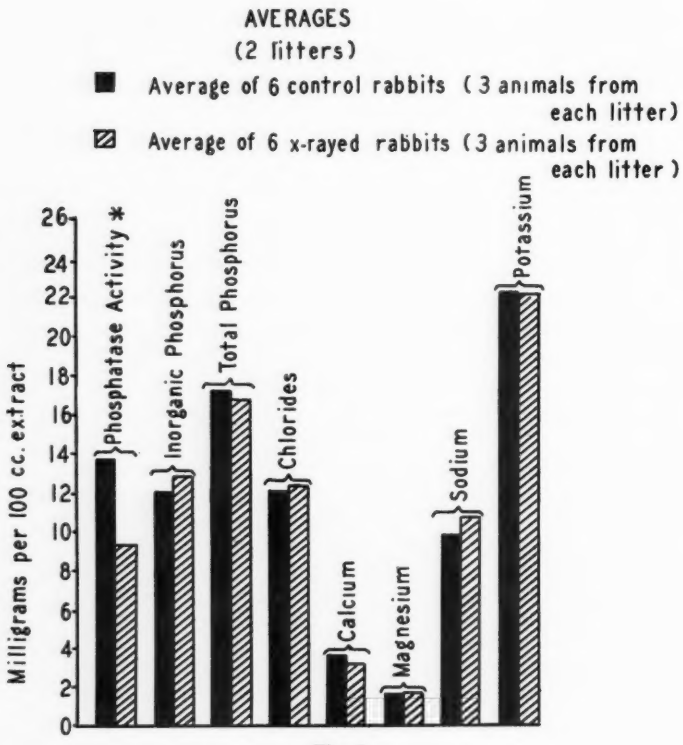

Fig. 1.

* See text for definition of the unit.

treated animals was below that of the lowest among the controls. In an experiment of this kind any change in the phosphatase activity of a given tissue may, of course, be masked by differences in other tissues. In unpublished studies we have found, for example, that while x-ray decreases the phosphatase activity of kidney, the decrease is much less marked than in growing bone subjected to a similar dose.

Whether the decrease is actual or merely apparent, due to inhibitory substances, we cannot say. Also, we are unable to say whether or not there is a functional

Phosphorus, calcium, and magnesium are known to influence phosphatase activity at least *in vitro*, and we were particularly desirous of determining whether changes in the concentration of one or more of these were responsible for the lowered phosphatase activity following x-ray therapy. As regards the inorganic substances studied, we feel entirely safe in stating that the decrease in phosphatase activity found in the irradiated animals cannot be attributed to changes in concentration of phosphorus, chlorides, calcium, magnesium, sodium, or potassium.

TABLE I

Animal number		Age of litter at time of treatment (days)	Dose of x-ray (roentgens)	Weight at time of treatment (grams)	Weight at time of sacrifice (grams)	Duration of extraction (hours)
Control	D1–C1	Preliminary*	..	..	..	..
	D1–C2	25	None	..	785	48
	D1–C3	25	None	..	810	48
	D1–C4	25	None	..	760	48
	Avg.	25		..	785	48
Treated	D1–X1	25	550	..	695	48
	D1–X2	25	550	..	710	48
	D1–X3	25	550	..	765	48
	Avg.	25	550	..	723	48
Control	D2–C1	31	None	970	1,265	36
	D2–C2	31	None	935	1,140	36
	D2–C3	31	None	930	1,185	36
	Avg.	31	..	945	1,197	36
Treated	D2–X1	31	1,100	1080	1,010	36
	D2–X2	31	1,100	1025	945	36
	D2–X3	31	1,100	970	875	36
	Avg.	31	1,100	1025	943	36

* This animal was sacrificed before the others and used to determine the amounts of extract to use for the various determinations.

SUMMARY

Three young rabbits from each of two litters were given 550 to 1,100 roentgens of deep x-ray over the entire body, the three other animals from each litter being used as controls. At the end of one week after treatment all twelve of the animals were killed, ground in a meat chopper, and extracted with ten parts (by weight) of distilled water. The extract was studied for phosphatase, total phosphorus, inorganic phosphorus, chlorides, calcium, magnesium, sodium, and potassium. The phosphatase activity of the irradiated animals was appreciably lower than that of the corresponding controls. No appreciable changes could be detected in the concentration of any of the other substances studied, indicating that some further factor is responsible for the reduction of phosphatase activity.

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THE ORGANIZATION OF THE CANCER CAMPAIGN IN THE UNITED STATES OF AMERICA[1]

By ALBERT SOILAND, M.D., *Los Angeles, California*

Secretary of the United States Delegation to the Fourth International Congress of Radiology, Zurich, Switzerland

THE honor of being permitted to present before this distinguished group of international medical experts the organization of the cancer campaign in the United States of America is deeply appreciated. There is, in all the world, probably no greater responsibility before the medical profession to-day than that of a solution, if humanly possible, of this most devastating disease of modern civilization. It is not a single problem nor a simple one. It demands, first, the education of those lethargic members of our own profession to awaken them into the realization of a duty which is so pertinently their own. Next, to intensify and amplify this education to a point that it may spread over onto the whole public at large in a manner which will remove the fear of cancer and encourage the seeking of assistance from medical advisors at a time when the disease can be scientifically and successfully subjugated. Thirdly, the nation's very government should be made to realize the highly important economic phase of this problem, to the end that appropriations should be directed into channels of scientific research in order that the people may learn, live, and prosper according to their rightful fundamental heritage.

The writer realizes full-well that in the short ten minutes allotted this subject, only the briefest kind of a survey is possible; hence he craves your indulgence for this sketchy and necessarily abbreviated report.

The United States Government is one of the few remaining nations which has not officially, as yet, recognized cancer as a major civic and economic problem. In other words, there is here no national governing body with authority to investigate into and seek ways and means to check the ravages of this devastating scourge of modern civilization—cancer.

As far as the writer is aware, only two States in the union, New York and Massachusetts, have state-controlled institutions where cancer research and cancer treatment are afforded their constituent citizens; and he is happy to state that both these institutions are under the control of high-grade medical men skilled in the direction and use of all modern weapons of warfare against this disease, including surgery, adequate x-ray equipment, and ample radium facilities. There are also several States, of which California and Pennsylvania are pioneers, where cancer commissions, sponsored by their state medical societies, are doing splendid work in publicizing the importance of cancer study and control to their own medical members and to the public at large. That this is bearing fruit is evidenced by the fact that the public is becoming more cancer-minded, thus co-operating with their medical advisors in the earlier stages of the disease, permitting the proper kind of treatment to be instituted at such a time as may assure a permanent cure, which otherwise would be impossible.

In addition, there is in America a privately endowed organization known as the American Society for the Control of Cancer, which is doing a monumental service for our public. This Society, with its director and headquarters in New York, has a number of highly qualified medical men who act as field agents and district representatives in various parts of the United States. These men call on the physicians in their territory and appear before the local medical societies, carrying the message of cancer education and pro-

[1] Presented before the Fourth International Congress of Radiology, at Zurich, Switzerland, July 24–31, 1934.

phylaxis into every group to which they gain access. They are performing a splendid service in the interest of humanity.

The American College of Surgeons, one of America's outstanding surgical bodies, has for several years been actively interested in cancer diagnosis and treatment. It has been my good fortune to have become personally acquainted with some of the leaders of this College and to learn of the extensive program of cancer research which the College is undertaking and sponsoring. Not only has the American College of Surgeons assisted in standardizing a great many of America's public and privately owned hospitals, but it has also been engaged in establishing cancer clinics throughout the United States wherever it finds a hospital or a clinical group sufficiently equipped both by personnel and apparatus to render a true cancer service in the community. This movement has accomplished more, perhaps, than that of any other single organization or group of organizations in America.

The American Medical Association, with a membership representing practically all ethical practitioners of medicine and surgery in the United States, is conducting a series of national network radio programs which reach the public in practically every town and hamlet throughout the country. These programs of cancer education are expressed in a language that every one can understand, and are, therefore, a tremendous help to our national cancer campaign.

Another very worthy activity is the work being done by one of the world's largest life insurance companies—an effort which is accomplishing something that would be practically impossible by the average medical or surgical group. Over the name of this insurance company, full-page statements are being made to the public through our leading national magazines, calling attention to the necessity of combating cancer by the closest possible co-operation with the regular medical profession. Attention is called to the neglect on the part of the average sufferer in seeking the proper kind of advice—often bringing disastrous results at the hands of the charlatan, the quack, or some other ignorant and unqualified cultist. These published warnings state, in no uncertain terms, that the only effective agent for combating cancer at the present time is the skillful professional use of surgery, x-rays, and radium. For this splendid and voluntary co-operation from an organization fully qualified to speak with authority, the medical profession, as well as the general public, owe a debt of sincerest appreciation and deepest gratitude.

Many other individual private hospitals which have been endowed by public-spirited citizens are augmenting cancer investigation, research, and treatment in a highly commendatory manner. It is impossible to name all, but I wish especially to mention the Rockefeller Institute, which maintains a splendid laboratory devoted to this work; the Memorial Hospital of New York, under the able guidance of that stalwart American scientist, Dr. James Ewing; Johns Hopkins Hospital and University of Baltimore, with Howard Kelly, Curtis Burnam, and the dean of all American cancer students, Joseph Colt Bloodgood; the Crocker Foundation of New York, under the leadership of Francis Carter Wood, whose contribution to cancer research through the "American Journal of Cancer," of which he is Editor, has opened our eyes to the magnitude of the cancer problem; the Steiner Cancer Clinic of Atlanta, Georgia; the Christian Cancer Foundation of the University of Minnesota; the Harvard Cancer Commission, and several others.

Returning to California, mention must be made of the California Institute of Technology, where America's outstanding physicist, Dr. R. A. Millikan, has developed scientific research on a parallel second to none. It was here that the writer first became interested in (real) short wave x-rays, and it may be news to some of our audience to know that in this institution the first experimental treatment of a cancer patient by means of x-rays generated

at a voltage over a half-million, took place in the Fall of 1930. At that time Dr. C. C. Lauritsen, Associate Professor of Physics, working under Dr. Millikan, had been experimenting with the higher voltages and a vacuum tube of his own design and manufacture, in endeavoring to break down the nucleus of the atom. These gentlemen were finally prevailed upon to submit their apparatus to clinical tests upon patients with cancer beyond the reach of surgery or other therapeutic means. From this small beginning the California Institute of Technology has continued experimental treatment work upon cancer sufferers up to the present time, this Fall completing four years of clinical research work with voltages up to 1,200,000. It is hoped that very soon an official report upon this work may be forthcoming.

In addition to the foregoing there are a number of individuals, and their name is legion, who have sacrificed their very lives in an altruistic endeavor to control cancer by means of radio-active agents. It was my intention to name a few among those still living who have contributed so much to our knowledge of cancer treatment, but the task assumed such startling proportions that it was deemed best to omit it. I started out to select those of whom I had personal knowledge, and also ran over the list of radiological authors who had contributed meritorious articles through the medical press. It appeared, however, that it would be impossible to include a list of all such, without injustice, so I would suggest that, if one glances through the fellowship roster of the American College of Radiology, he will probably find therein those who have placed clinical radiology upon the highly respected professional plane it now occupies in the United States of America.

It is earnestly hoped that the results of the cancer campaign reports before this distinguished body of physicians and physicists at the Fourth International Congress of Radiology will prove of inestimable value to the members participating, and that the lessons therefrom may redound to the health and happiness of all mankind.

1407 South Hope Street

A ROENTGEN SIGN FOR SACCULAR ANEURYSM OF THE THORACIC AORTA

A PRELIMINARY REPORT

By E. BURVILL-HOLMES, M.D., *Conshohocken, Pa.*

From the Department of Roentgenology, Philadelphia General Hospital

ARE we dealing with a newgrowth or a thoracic aneurysm? This is a question to which the roentgenologist must frequently supply an answer in those cases in which the roentgenogram reveals a shadow of greater or less extent in the upper mediastinum. We say "frequently" advisedly, since aneurysms of the aorta are met with less commonly than formerly owing to the notable discovery by Ehrlich and the marked advancements that have taken place in recent years in the treatment of syphilis. However, they are, even now, by no means a rarity.

That the roentgenologist has to be the court of last resort in differentiating between these two lesions is due to the fact that the clinician, despite the history, symptoms, and physical examination, is not uncommonly at a loss to arrive at a definite conclusion. "A mediastinal tumor or aneurysm" is as far as he will venture, so that, to use the colloquial expression, he "puts it up" to the roentgenologist to render the final verdict. And, too, it is not only necessary to establish a diagnosis for diagnosis' sake, but upon its accuracy depends the institution of the proper remedial measures. In passing, it might be of interest to note that 10 per cent of our cases of aneurysms were clinically diagnosed pulmonary tuberculosis.

It is not our purpose here to discuss the pathology of aortic aneurysms further than to say that in our opinion all saccular aneurysms of the aorta are the result of syphilis. We anticipate some criticism for this statement but, nevertheless, it is our belief. It is true that in 10 per cent of our cases, serology was negative in all antigens, but laboratory findings are equally disappointing in cases in which syphilis is unquestioned. Furthermore, it is also true that in perusing the case histories of many of the patients in whom saccular aneurysms existed, and were subsequently substantiated with autopsy, we read that the patient disavowed a primary lesion. This we can, and do, attribute to the manner in which the history was elicited. To obtain honest and informative replies care must be taken in the wording of the question. "Have you ever had a sore?" will invariably meet with a denial for the reason that, the patient being only human, any reflection on his or her morals would dictate the answer "no," regardless of what the truth might be.

We always submit the patient to the psychological effect of roentgenoscopic examination and, at its conclusion, bluntly and without equivocation inquire, "How many years ago did you have a sore?" In this way we have never yet failed to secure a frank confession.

Boyd mentions infections such as influenza, typhoid, pneumonia, etc., as probable causes of adventitial inflammation, but adds that it is doubtful if sufficient weakening of the walls takes place to lead to aneurysm. He also says: "An infected embolus lodging in the vessel and extending to the media may cause a mycotic aneurysm. Congenital weakness of the media or a tuberculous mediastinal gland in contact with the aorta, giving rise to a local infection, as the result of which the wall may give way, may result in aneurysm." However, he concludes, "At best, these causes are so rare as to be doubtful."

Excluding the dissecting, true, false, and circoid, etc., we class all aneurysms as saccular. We do not subscribe to fusiform aneurysms. We do meet with fusiform dilatations but not fusiforman-

Fig. 1. Extensive destruction of the left half of the bodies and laminæ of the third, fourth, fifth, sixth, and seventh dorsal vertebræ by a large saccular aneurysm of the horizontal arch and proximal descending branches of the thoracic aorta. Dorsoventral view.

eurysms. We have experienced several cases in which the entire left hemithorax would be practically occupied by a large, fusiform-shaped dilatation of the descending branch which would probably be classed as a fusiform aneurysm. Nevertheless, at autopsy, a vessel will be found of normal size but with walls of "paper-like" thickness. These are fusiform dynamic dilatations often associated with marked tortuosity and are not fusiform aneurysms. In the past four years we have encountered, at the Philadelphia General Hospital, aneurysms as follows:

Horizontal branch, 22
Distal, ascending and horizontal, 19
Proximal descending, 18
All branches, 9
Proximal ascending, 5
Proximal descending, 5

In addition, we have had but have excluded as irrelevant to the report, two distal descending thoracic, two abdominal, and three of the common innominate.

As we have remarked before, it is often

ROENTGEN DIAGNOSIS

difficult, indeed impossible, to clinically differentiate tumors of the upper mediastinum from aneurysm. Pain, hemoptysis, cough, and physical findings are common to both, so that dependence has to be given to roentgenographic and roentgenoscopic findings.

Right here and now let us explode the common impression that a differential diagnosis between tumor and aneurysm can be made, by noting on the fluoroscopic screen pulsations of the latter and their absent in the former. In our experience, pulsation of the sac is decidedly the exception rather than the rule, probably because when these cases come under our observation the aneurysm has existed for a long time. And even in the few cases in which pulsations are observed it is often impossible to say whether such pulsation is expansile or transmitted. One has but to inspect the contents of one of these sacs at the autopsy table to readily appreciate why pulsations do not occur, or are so infinitestimal as not to be visible on the fluoroscopic screen. The blood coursing through a narrow channel precludes any appreciable registration of the pulse wave, owing to the layer upon layer of dense, laminated clot, which intervenes between it and the sac wall.

Our patients, nevertheless, are routinely examined by fluoroscopy though this procedure is not absolutely essential for diagnosis. In virtually all cases a dorsoventral roentgenogram of the chest rarely betrays us, with the exception of those aneurysms that involve the proximal ascending or distal descending branches, or in the rare cases in which the aneurysms are so small and so situated that they could be, and are, overlooked by any method of examination. In referring to the summary of our cases it will be noted that these exceptions constitute a very small portion of the total. However, for further refinements in diagnosis, in order to determine which portion of the branch, or branches, is involved, roentgenograms are

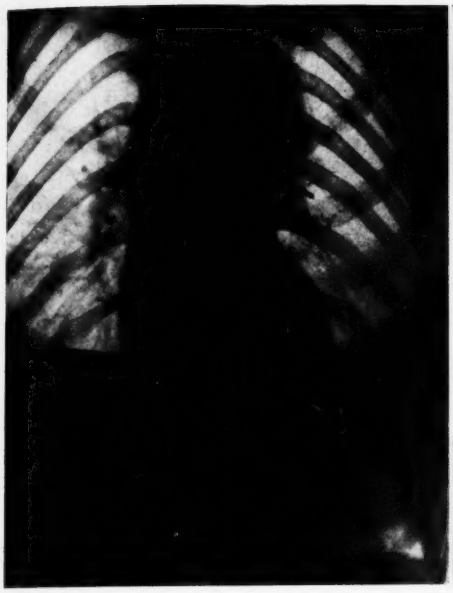

Fig. 2. Saccular aneurysm of the horizontal branch of the thoracic aorta. Negress, 24 years old. Note angle.

Fig. 3. Saccular aneurysm of the distal horizontal and proximal descending branch of the aorta. Note well defined semicircular indentation.

made in the right and left anterior oblique and sagittal projections. These latter are imperative if we are to detect any erosion of the vertebræ such is usually the case when the sac is large and projects dorsal-ward. In a single case we were enabled to demonstrate marked vertebral destruction in a dorso-ventral projection (Fig. 1).

Deviation of the esophagus, while not always present, is usual, but similar displacement can, and often does, occur in tumors. To determine this displacement it is our custom to administer a thick barium-buttermilk paste. A thick paste is utilized since it will remain *in situ* for a sufficiently long time to secure the necessary roentgenograms in all positions. Again, aneurysms practically always cast a markedly dense, homogeneous shadow for reasons which are obvious: newgrowths frequently exhibit similar density. In contra-distinction, however, fusiform dynamic dilatations, often erroneously diagnosed fusiform aneurysms, cast a shadow much less dense because the laminated clot is absent. Given a roentgenogram in the case of a negro in which a large, homogeneous shadow occupies the upper mediastinum, by the law of averages a diagnosis of aneurysm would undoubtedly be confirmed. But, while less common in this race than in the white, tumors are met with. As newgrowths occur less often in the negro than in the white, so do aneurysms in our experience, and in this country, occur more frequently.

What, then, is the diagnostic feature in the roentgenogram which provides the key to differentiate? For some time past we have made the observation that in all aneurysms, with the exceptions before mentioned, there is always a definite angulation between the outer limit of the sac wall and the left border of the heart. It may be a right-angle or an obtuse one: it may appear as a small arc of a circle. Perhaps the word "indentation" would be more descriptive. Furthermore, and this is of equal importance, is the inability to

Fig. 4-*A*. Erroneously interpreted as an aneurysm. Note the absence of solid angle and the visualization of the left border of the heart through the mass (more clearly outlined on the film).

Fig. 4-*B*. Composite line drawing of three aneurysms. Note angles at *A*, *B*, and *C*.

trace the left border of the heart beyond the lower limit of the sac wall. The border of the heart fuses, as it were, with the dense shadow of the aneurysmal sac. Occasionally it can be traced beyond the latter, but, if so, only for a distance of approximately one to two centimeters. In contrast, in cases of tumor, this angulation is not present, and the border of the heart can be traced from its apex to the aortic arch. The idea which we wish to convey will be more readily understood if reference is made to the accompanying roentgenographic reproductions (Figs. 2 and 3) and also the lined drawing—a composite of three aneurysms (Fig. 4).

Figure 2 is a case on the service of Dr. McLean, from the department of tuberculosis. The patient was a negress, aged 24 years, whose chief complaint was pleuritic pains over the left lower chest for the previous five days. Her history was that about a month prior to admission she began to lose weight, but her appetite remained good until five days before, at which time she became weak and listless. There was never any cough, expectoration, or hemoptysis. Five days before admission she suffered with sudden, stitch-like pains which were worse on deep breathing but were relieved by strapping. Physical examination was virtually negative, and the sputum negative for tubercle bacilli. The patient was referred to the x-ray department with a clinical diagnosis of pleurisy and a tentative one of pulmonary tuberculosis.

The film of this patient prompted much discussion and opinions were divided as to whether it was a newgrowth or aneurysm. Because of the youth of the patient a majority considered aneurysm as entirely problematical, but the telltale angle was present and we unhesitatingly made a diagnosis of saccular aneurysm of the horizontal branch of the aorta. While

this case is not proven (since the patient, after a few days in the hospital, requested and received her discharge), however, we feel sure that, despite the patient's age, she has an aneurysm. We might add that, before her discharge, we were informed that serological tests were strongly positive in all antigens.

Another patient, also a negro, aged 49, was on the service of Dr. William Drayton in the psychological department. His chief complaint was intense pain in the chest. The pains, he stated, began five years before admission, in the left shoulder, migrating to the chest. For the past two years, however, he had been free from it but it returned six months ago. When he lies down he becomes very dyspneic. According to his past medical history he had "blood poisoning" ten years ago. He, however, denied a primary lesion. Physical examination showed impaired fremitus over the left chest, with impaired percussion note. Over this side, also, breath sounds were distant and a few expiratory râles were present. There was no precordial bulging. The apex was visible and palpable in the fifth interspace inside the midclavicular line. There were no thrills. Heart sounds were normal and no murmurs or bruit could be detected. Blood pressure on both sides: 140/90. Serology was as follows: chol. antigen, one plus; Nougouchi, minus; Kahn, three plus. A clinical diagnosis was made of either mediastinal newgrowth or aneurysm. Autopsy showed a large saccular aneurysm involving the distal horizontal and proximal descending branches. The aneurysm had ruptured into the left upper lobe of the lung (Fig. 3).

This film, likewise, caused no little discussion and opinions were varied. The widespread shadow, occupying much of the left hemithorax and lacking any well-defined outline, tended to confuse and confound. Here again the angle could be demonstrated, although faintly, and furnished the basis of a roentgen report of a saccular aneurysm.

Figures 4-*A* and 4-*B* are illustrative of the signs to which we have drawn attention. I. M., negro, aged 46 years, was admitted to the nervous wards on the service of Dr. Yaskin, because of a left-sided hemiplegia. Owing to his inability to talk, only a brief history was obtainable, but his wife who acted as informant said that he had been a regular attendant at an out-patient clinic, where he was given "shots" in the arm for "bad blood." Upon awakening in the early morning of the day on which he was admitted to the hospital, she found him paralyzed, being unable to talk or move his left arm and leg.

In conclusion, we do not wish to convey the idea that this angle will be present in every case, or that, if present, it is infallible for a diagnosis of aneurysm. There are exceptions to all rules. It is conceivable that a large upper mediastinal tumor could extend outward and downward on the left side, obscuring the left border of the cardiac shadow, and that its upper border might form an angle with the latter. This must be rare, however, as we have never yet experienced it. An error, if it is made, will lie largely in mistaking a newgrowth for an aneurysm rather than the reverse.

The patient had a large pulsating mass in the supraclavicular region of the right side. It was freely movable and an auscultatory bruit was heard over it. There was no precordial bulging, but there was a widespread heaving pulsation. No palpable shock or thrill was felt. The heart was greatly enlarged as evidenced by the area of cardiac dulness. A systolic and diastolic murmur was appreciable. Pulse was of the water hammer type. Blood pressure was 190/68 on the right arm and 160/82 on the left. Blood and spinal fluid was 4 plus in all antigens, and a paretic gold curve was obtained.

In the light of the history, physical and laboratory findings, a clinical diagnosis of right cerebral thrombosis, cardiovascular syphilis, with aneurysm of the aorta and innominate, was made. In referring to the reproduction of the roentgenogram of the patient's chest, it will be noted that there

is an absence of the solid angle invariably seen in cases of saccular aneurysm of the aorta. Furthermore, and just as important, the left ventricular border can be traced through the shadow of the circumscribed mass (more sharply defined on the original film).

That the signs were of value in refuting the opinion that no aneurysm was present was borne out by the postmortem findings. No evidence of any aneurysm either of the aorta or innominate was found. The former was considerably dilated and presented many diffuse and puckered scars with wrinkling of the intima. The dilatation was fusiform, the caliber of the arch being 10 centimeters. The innominate was likewise dilated, with fibrosis of its walls.

SUMMARY

We have attempted, briefly, to describe a new sign whereby tumors of the upper mediastinum can be differentiated from saccular aneurysms of the thoracic aorta.

In the latter, a definite angulation is formed by the lower left border of the heart with the lower border of the aneurysmal sac; in addition, and equally important, is that the left border of the heart cannot be traced through the dense shadow cast by the aneurysmal sac.

While we do not claim infallibility for this sign, our experience has shown that it is of considerable value in the differentiation of the two lesions. We have never observed the sign in cases of tumor.

ROENTGENOLOGIC METHOD OF EXAMINATION OF THE LYMPHATIC SYSTEM IN MAN AND ANIMALS[1]

By A. ZOLOTUKHIN, *Leningrad, U. S. S. R.*

From the Laboratory of Normal and Comparative Anatomy at the State Roentgenologic, Radiologic, and Cancer Institute

(Director of the Institute, Professor M. I. Nemenow; Head of Laboratory, Professor A. Zolotukhin)

IN 1928, at the suggestion of Professor M. I. Nemenow, the Director of the Institute, our laboratory took up the task of working out a roentgenologic method of examining the lymphatic system. Owing to the fact that there is not a single branch of practical medicine which is not interested in the lymphatic system and considering the importance, the difficulty, and the responsibility of the work, the laboratory set about the task, having included it in the plan of its work as one of the main problems.

The first year of work resulted in reassuring findings, as it enabled us to answer in the affirmative the question as to whether or not it was generally possible to introduce a contrast substance into the lymphatic system of a living animal and to have it reproduced by means of a roentgenogram.

The experiments were carried out on frogs, as the introduction of a contrast substance into their large subcutaneous pouches presented no difficulty. The frog was either slightly anesthetized or even received no narcosis whatever, and a number of serial roentgenograms were then made, revealing the penetration of the contrast substance into both the anterior and posterior lymphatic hearts. The frogs bore the experiment well and as a rule survived, so that it was possible to make further roentgenograms at different intervals up to the twenty-first day. In a number of cases the contrast sub-

Fig. 1.

Fig. 2.

[1] In a personal communication the author says: "Generally speaking, all the data appearing in this article will first appear in RADIOLOGY. The data obtained in 1928, as a result of the experiments on frogs, have not yet been published, and have not been communicated to anyone. The same can be said of the data obtained on rabbits." The literature available to him, writes the author, does not contain any earlier communications on the investigation of the lymphatic system by means of the roentgen ray.

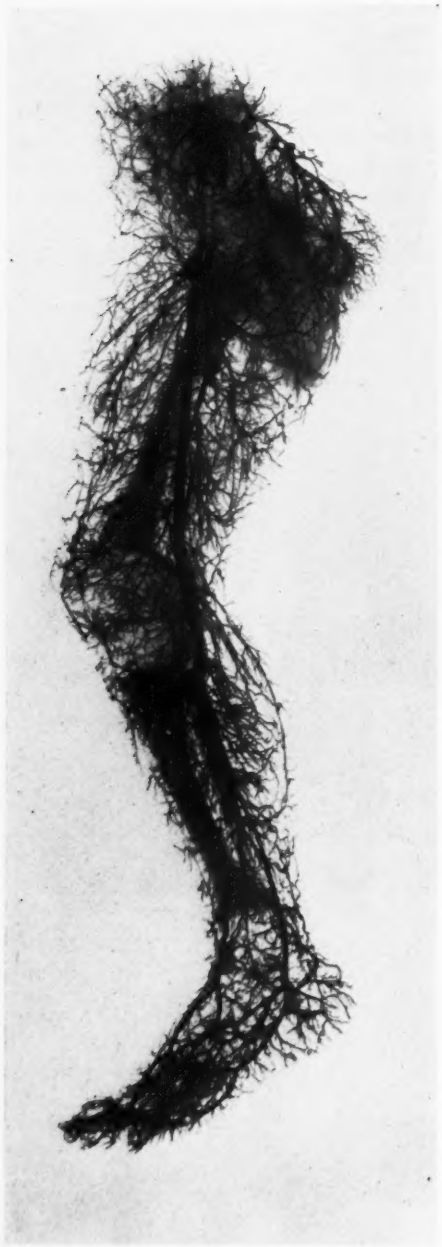

Fig. 2-*A*.

stance having disappeared from the lymphatic hearts, it was observed in the spleen. The findings have been the subject of a special paper.[2]

[2] A. Zolotukhin, V. Karasik, 1928.

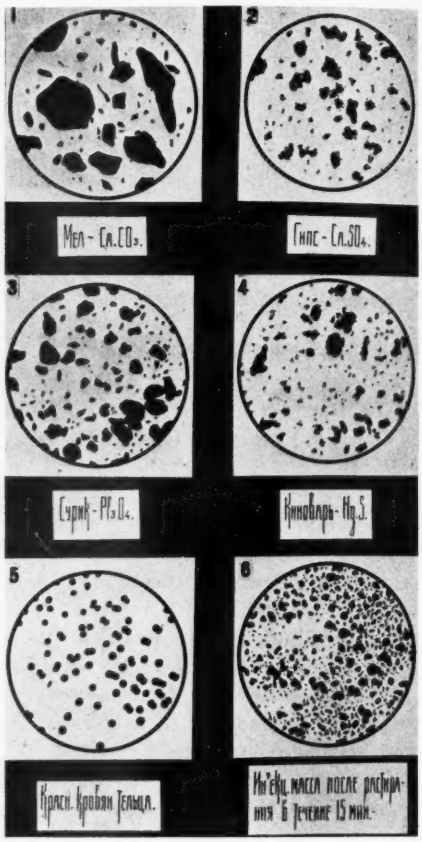

Fig. 2-*B*.

Figure 1 is a roentgenogram showing a phase of one of the experiments made Sept. 29, 1928. Animal, *Rana temporaria;* male; size, average; no narcosis or any other pharmacologic administration. Subcutaneous injection of: (1) 0.3 grm. of Sol. Natr. Brom. 20 per cent, into the right crural region; (2) 0.4 grm. of Bismuth. Carb. Suspens. into the left crural region. The roentgenogram was made 18 seconds later. It shows distinct outlines of a contrast band on the left which spreads from the shin to the lymphatic heart along the whole of the thigh, and a less marked contrast band on the right which is manifest only within its initial limits, spreading no farther than up to the middle of the thigh.

Figure 2 is one of the serial roentgenograms showing the experiment carried out on Oct. 27, 1928. Animal, *Rana temporaria;* male; size, average; small ulcer on the skin of the left upper eyelid; reproducing the different organs and parts of the body of man and laboratory animals. This work has made it possible to give a better grounded and more detailed answer to the question we set out to answer.

Fig. 3.

Fig. 4.

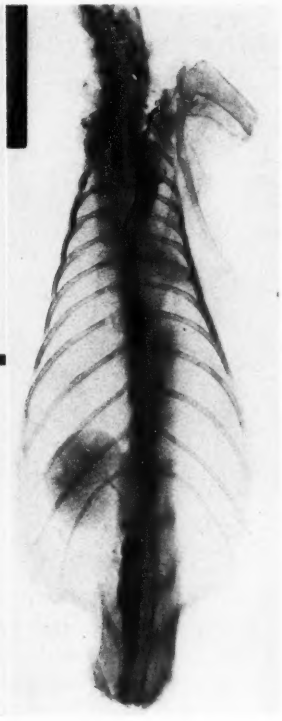

Fig. 5.

receives neither narcosis nor any pharmacologic administration; subcutaneous injection of 0.1 grm. of Bismuth. Carb. Suspens. in gum arabic into the left crural region and of the same quantity into the right humeral region. The roentgenogram, taken on Oct. 29, 1928, *i.e.*, in 48 hours' time, reveals the accumulation of the contrast substance in the region of the posterior and anterior lymphatic hearts; no connection with the site of injection can be established.

In the course of the last two years we have carried out over 120 experiments and have made about 250 roentgenograms

Notwithstanding the facts that in 1929 Defrise demonstrated at the Congress of Italian Anatomists, in Bologna, several roentgenograms of the lymphatic system injected with silver nitrate; that in 1930 Gaetano Ottaviani applied the injection of mercury on human corpses, and those of domestic animals, and that in 1931 Oscar Meller applied umbrathor to the injection of lymphatic vessels of the lungs, it was a fact that, so far as the writer knew, no definite roentgenologic method for examining the lymphatic system had been established.

Due to this fact our laboratory deter-

Fig. 6.

Fig. 7.

Fig. 8.

mined on starting with the injection which has been known since the days of Nuck (1692) and has become classical. However, owing to the peculiarities of the roentgenologic method, we considered it essential that any substance introduced for exploratory purposes should be possessed of the contrasting capacity, and that the injection should be complex, *i.e.*, we decided on introducing a topographic injection and thus obtaining a stereoroentgenogram. During the last year the methodical part of the problem set has been considerably advanced since the time when the work was placed in the charge of Dr. Jdanov, who has made all the further described anatomic sections.

The following substances have been tested on anatomic material: (1) the essential substances of the Hauch, the Gerota, and the Hazin type; (2) the experimentally obtained modifications of the latter, and (3) substances worked out at the laboratory by Dr. A. Zolotukhin and Dr. D. Jdanov.

Figure 3 is a roentgenogram showing the subcutaneous lymphatic vessels of the upper extremity of an adult; Figure 4, the lower extremity, the injections of mercury having been made into the skin of the finger and the toe, respectively. Such a roentgenogram as Figure 3 is the exact reproduction of the lymphatic system of the forearm and reveals the distribution of the vessels, the nature of the anastomoses of separate branches and their coils, and the line of their direction toward the lymphatic glands. The high atomic weight of mercury is its advantage, its high specific gravity, its drawback, considerably limiting its application.

Figure 5 is a roentgenogram showing the entire thoracic duct of a rabbit.

Owing to the application of a complex,

topographic injection with two substances differing in their atomic weights the roentgenogram reproduced as Figure 6 not only shows the subcutaneous lymphatic vessels but the arterial system as well.

Figure 7 shows the main subcutaneous lymphatic vessels of the posterior extremity injected with white lead ($2PbCO_3$-$Pb/O/H)_2$. The vessels are satisfactorily contrasted, well outlined, and can be seen even against the background of osseous tissue. The vessels, numbering five (vasa afferentia), run toward the lymphatic gland and, having passed through it (vasa efferentia), emerge as a smaller number, for only two vessels are then discernible; however, one of the two, namely, that running to the nearest lymphatic gland, again ramifies into three branches.

Figure 8 is a roentgenogram showing an analogous picture with a modified interrelation of contrasts observed in the vasa afferentia and the vasa efferentia at the expense of the two lymphatic glands being more markedly contrasted, having retained in the glandular filter the contrast substance, *i.e.*, a 30 per cent solution of collargol.

Fig. 9.

Figure 9 is a reproduction of the right anterior extremity of a dog and shows a fascicle of superficial lymphatic vessels, consisting of four stems having marked dilatations at the site of valves (vasa afferentia). Only two vessels emerge from the gland but those are of greater diameter (vasa efferentia) and the cranial one soon bifurcates. In their further course the three vessels considerably increase in diameter, the distinct contours of the truncus jugularis, with marked swellings at the site of valves, being visible in the cervical region.

Figure 10 is a roentgenogram reproducing a topographic, *i.e.*, complex, injection of three systems—the arterial, the venous, and the lymphatic. Stereoscopic examination reveals the interrelations between the aortic arcs (and the larger branches of the aorta), the vena cava superior, and the lymphatic duct.

All the above-described findings have

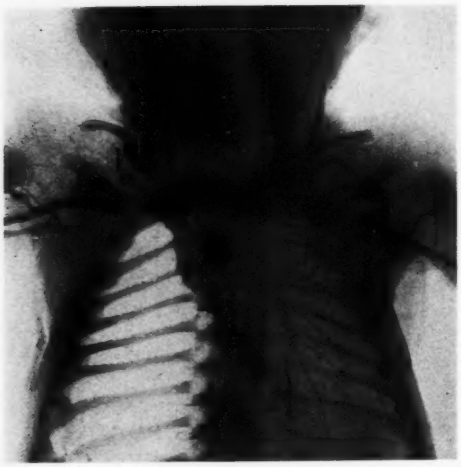

Fig. 10.

been reproduced in anatomic sections obtained by means of a special anatomic method of procedure, designed to meet the peculiar roentgenologic requirements.

Figures 11 and 12 are roentgenograms obtained as a result of a physiologic experiment. Rabbits having received a light dosage of anesthetic were injected intracellularly with a 30 per cent solution of collargol into the anterior extremity and the skin of the toes. The lymphatic vessels, which are well contrasted against the bone, are distinctly visible (Fig. 11); they run from the site of injection to the nearest lymphatic glands of the axillar (Fig. 11) and popliteal regions. Figure 12 shows the lymphatic vessels of the two lower extremities.

Fig. 11.

CONCLUSION

On the ground of the work completed it is now possible to affirm that the application of the roentgenologic method to the examination of the lymphatic system of man and animals will doubtless help to bridge over a number of lapses which have so far existed in the fields of morphology and physiology.

The problems consist of establishing the connection between the superficial and the deep-lying lymphatic vessels of the extremities, those of various organs and of the different regions of the body (such as the mediastinum), as well as the connection between vessels running in different regions, which is of such great importance in practical medicine. These problems and the study of the routes along which the lymph flows, *i.e.*, the study of lymph circulation under pathologic conditions in particular, are essential problems whose solution may be facilitated and promoted by including in the methodologic complex the roentgenologic method of

examination. The solution of these problems will render more accurate our knowledge concerning this complicated and important branch of the morphology and physiology of man and animals.

METHOD OF PROCEDURE

The following substances have been applied for injecting the lymphatic system in anatomic material: (1) the essential substances of the Hauch type, namely, red lead (Pb_3O_4), 120.0 gr.; paraffin oil, 120.0 gr.; oil of turpentine, 60.0 gr.: the Gerota type, namely, red lead (Pb_3O_4), 5.0 gr.; oil of turpentine, 3.0 gr.; chloroform, 5.0 gr.: the Hazin type, namely, glycerini fl., 100.0 gr.; bismuth carb., 20.0 gr.; ag. destil., 10.0 gr.: (2) their experimentally obtained modifications, and (3) substances worked out at the laboratory by Dr. Zolotukhin and Dr. Jdanow, $(2PbCO_3Pb(OH))_2$, 60.0 gr.; paraffin oil, 45.0 gr.; oil of turpentine, 130.0 grains.

The substance injected for roentgenologic examination should meet the following three essential requirements: it should be possessed (1) of a contrasting capacity; (2) of a high degree of penetrability, and (3) be fine, *i.e.*, consist of an emulsion with very minute particles or grains.

The above-mentioned Hauch's substance may be considered as essentially suitable for the purpose of injecting the blood, vascular system, and the arteries in particular, on condition that its penetrability be increased by a modification in the ratio of its constituents (60.0 gr., 45.0 gr., 80.0 gr., respectively), and that the particles of red lead (Pb_3O_4) be very minute.

Figure 2-*A* is a roentgenogram showing the entire arterial tree of the lower extremity injected with Hauch's substance, the size of the emulsion grain exceeding but slightly the diameter of an erythrocyte.

The crushing of the substance applied for injecting is best performed by a mechanized method with the aid of a fine grinding machine such as is used for chemical purposes. A porcelain or agate mortar insures a fine grind which is rapidly obtained, while by graduating the contents of the pestle (which sometimes reaches as much as 2500 grm.), a standard mass is warranted.

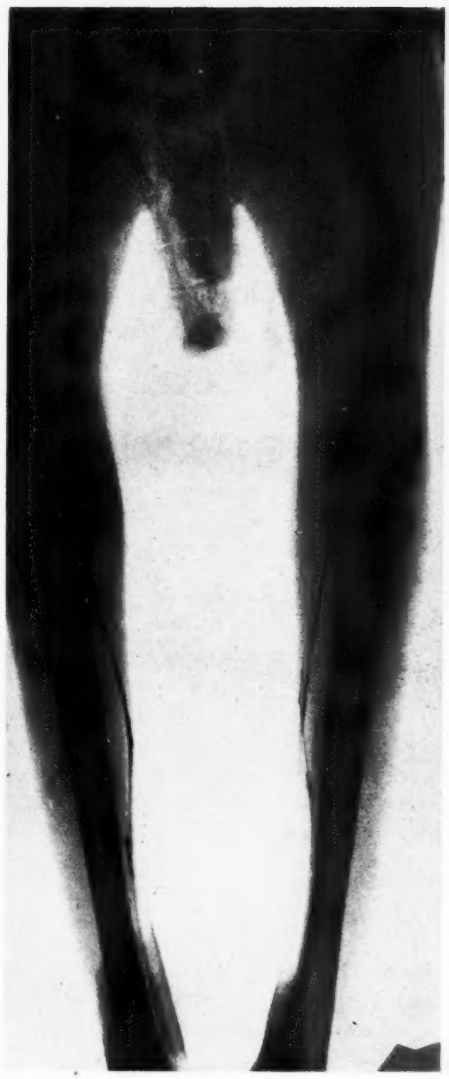

Fig. 12.

Figure 2-*B* is a tracing, made by means of Abbee's device, for microscopic drawing of the different equaly magnified particles constituting the substance used for injection, previous to their having been crushed: No. 1, $CaCO_3$; No. 2, $CaSO_4$;

No. 3, Pb_3O_4; No. 4, HgS. No. 6 is a tracing of the particles subsequent to a crushing of fifteen minutes' duration and shows that these but slightly exceed in size the diameter of an erythrocyte (No. 5).

The crushing must be done much more thoroughly if the lymphatic system is to be injected, particularly so in case of a parenchymatous injection, and may require as long as from two to three hours. After similiar crushing the particles of the substance are of very small diameter (3–5μ) and readily penetrate in the intracellular spaces. A thoroughly prepared substance insures a successful injection and a demonstrative section.

The injection requires no special devices and is performed by means of an ordinary Record syringe with a fine needle. In injecting the subcutaneous lymphatic vessels in man (Figs. 3, 4) or animals (Fig. 9) the procedure is begun by inserting the needle into the skin of the finger or toe in the region of the ungual phalanx on the surface of the flexor: later after a large subcutaneous lymphatic vessel has been revealed the needle may be introduced into the latter and the injection continued until the vessels reaching as far as the nearest regional lymphatic glands (*i.e.*, either popliteal or ulnar) are filled with the substance. In case the vessels retain the contrasting substance (Fig. 8) it is possible to continue the injection by inserting the needle into the gland itself (Fig. 9) and in this way obtain the contrasted contour of the vessel in its further course.

The thoracic duct is successfully injected by inserting the needle into the inguinal lymphatic glands (Fig. 5).

With the purpose of performing a complex topographic injection of several vascular systems (either of two or of three, namely, the arterial, the venous, and the lymphatic (Figs. 6, 10), it suffices to substitute the essential contrasting substance for the subsequent injection with one of a greater or smaller atomic weight, as it is the latter property that determines the contrasting capacity: white lead $(2PbCO_3PbOH)_2 = 774.7$; red lead ($Pb_3O_4 = 684.7$); cinnabar ($HgS = 232.06$).

Due to the fact that substances of the nature of an emulsion cannot be satisfactorily used for injecting the lymphatic system in living animals, we have tested for the purpose a series of both simple and colloidal solutions (salts of bromine, strontium, lipiodol) and the best results were obtained by the application of a 30 per cent solution of collargol. In this case as well, the solution is injected by means of an ordinary Record syringe, either subcutaneously or intramuscularly or into the arthral cavity of a slightly anesthetized animal, and then the roentgenogram is made (Figs. 11 and 12).

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A STUDY OF THE EFFECT OF IRRADIATION UPON THE LUMBAR SYMPATHETIC GANGLIA IN RATS[1]

By J. Q. GRIFFITH, JR., M.D., Instructor in Medicine *and* Kerkscher Fellow in Medical Research, and E. P. PENDERGRASS, M.D., *Philadelphia*

SINCE 1930, we have been interested in the treatment of cases of angina pectoris with roentgen therapy. It was thought that the effect of irradiation, if any, was upon the sympathetic ganglia, and that pain was relieved in a manner analogous to the relief sometimes obtained after alcoholic injection. A similar line of reasoning was used by others in the justification of roentgen therapy in many diverse conditions, including Raynaud's disease, lichen planus, pruritus, and dysmenorrhea. It soon became obvious that it was extremely difficult to evaluate the results. Patients with angina pectoris frequently pursue a very variable course; they are of necessity treated with several therapeutic agents simultaneously. An improved morale and spirit of optimism may in certain cases mislead both patient and physician as to the true progression of the condition. The technic of roentgen therapy entails manipulations which may act powerfully on the psyche. Thus it was found that, while many cases of severe angina showed improvement, and so stated, they all tended to relapse. Other persons with anginoid pains, definite nervous disturbances, but little in the way of organic cardiac findings, might remain permanently improved.

It seemed desirable that some objective experimental data be procured, preferably on animals, bearing upon the basic question: Can roentgen irradiation affect the sympathetic ganglia? The following three possible procedures suggested themselves:

(1) Irradiation of the ganglia *in situ* and subsequent microscopic examination. The objection to this was technical. It is uncertain what degree of damage to a ganglion must exist before it is apparent in the fixed stained preparations now available. It is probable that an attack upon the problem in this manner would require the development of an entirely new technic.

(2) After ganglionectomy the temperature of the skin which has suffered an interruption of its vasomotor nerve supply will be relatively high, at least for a time. It is customary to compare corresponding parts on opposite sides. This method is satisfactory and simple following operative procedures, which can easily be unilateral. The proximity of the paravertebral ganglia to each other, especially in small animals where they may lie only from 2 to 3 mm. to each side of the midline, practically precludes the use of this method following irradiation.

(3) After ganglionectomy the peripheral sympathetic nerve plexuses, lying in the adventitia of blood vessels, degenerate. This degeneration is complete in from 45 to 60 days. It was realized that failure to obtain this degeneration would not necessarily mean that there had been no effect on the sympathetic ganglia, but only that the effect was not comparable to operative ganglionectomy. This was the method chosen.

Considerable preliminary work was required to determine the dose of irradiation to be employed, and to work out the technic for staining the peripheral sympathetic vascular plexuses. It was found that a considerable number of white rats would survive doses of roentgen irradiation given along the paravertebral gutters. The factors were as follows:

Voltage, 165 K.V. The machine is a Kelley-Koett transformer with a single LaTour circuit with a ripplage current, the ripple being from 8 to 12 per cent at 15 milliamperes.

[1] From the Robinette Foundation, the Medical Clinic, the Department of Radiology, and the Pepper Laboratory of the Hospital of the University of Pennsylvania.

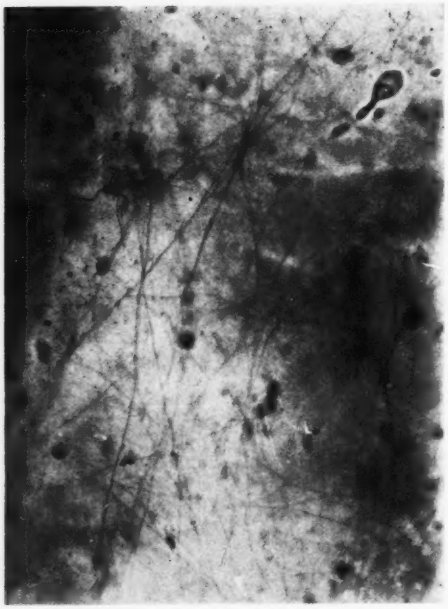

Fig. 1. Sympathetic nerve plexus in the adventitia of the femoral artery of the rat, stained with methylene blue.

Current, 15 ma.;
Filter, 0.5 mm. of copper;
Distance, 50 cm.;
Time, 20 minutes, continuous over one field;
Roentgens, 800, as measured in air;
Portals, 3 × 6 cm. This allowed simultaneous treatment of the sympathetics on both sides of the spine.

Method.—White rats of average weight (150 gm.) and about four months old were used. The results reported are based upon 16 irradiated animals and two controls (operated upon). Thirty-five other animals died of various causes at varying times during the experiment: the 18 represent the survivors.

The animals to be irradiated were first anesthetized with nembuttal, 5 mg. per 100 gm. of rat, given intraperitoneally. Each animal was then placed on its abdomen, supported with sand bags on each side, and covered with a lead shield. This shield had an opening arranged to expose an area 1.2 cm. on each side of the spine below the level of the thorax. This area was then given 800 r. The animals were then permitted to recover and kept in as good condition as possible for a period of 60 days. At the end of this time each animal was again anesthetized by the same technic. A midline abdominal incision was made, the viscera displaced, and a glass cannula inserted into the abdominal aorta and tied in place. Through the cannula the lower extremities were then perfused with a solution of 1 to 5,000 methylene blue nach Ehrlich in physiologic saline at a temperature of 37 to 39° C. and under a constant pressure of 95 mm. of mercury. It was found that as soon as the flow began the toes turned blue. Soon the liver began to swell and at this point it was usually necessary to make an opening in the vena cava system. This could easily be done by cutting through the renal vessels on one side with a pair of scissors. If the animal was not already dead, he died at this point. The skin was cut away over the femoral vessels. This seemed to improve staining, perhaps by giving access to oxygen. The perfusion was continued for a period of one hour. As the result of following this procedure in over a hundred animals, we wish to make three technical points:

(1) As long as the toes are blue the perfusion is flowing.

(2) The perfusion must continue for at least an hour. It seems to make little difference whether 250 c.c. or 1.5 liters pass in this time; the average will be about 700 cubic centimeters.

(3) If the skin over the femoral vessels is cut away only in places, it will frequently happen that the artery will be a deep blue in these places and a pale blue under the intact skin. On microscopic examination, the sympathetic network will show best or perhaps only in the deep blue areas.

After the perfusion was stopped the femoral arteries were dissected free and removed. They were placed on glass wool in a dish and sprayed for five minutes with the same methylene blue solution used in the perfusion. They were then immersed in an ice-cold solution of 8

per cent ammonium molybdate to which 5 drops of 1 per cent osmic acid had been added per 100 c.c., and left in the ice box for 24 hours, for fixation. The tissue was washed for a half-hour in distilled water at room temperature, and dehydrated by passing through four changes, a half-hour each, of absolute alcohol. It was then left in oil of wintergreen for 24 hours. Next, after washing in xylol for from three to five minutes, the vessels were cut into segments of convenient size, spread on a slide, and mounted in balsam. The sections were clamped by a spring clothes pin, for compression, for from five to seven days until the balsam hardened. The slide was cleaned and made ready for examination.

In specimens obtained in this manner from normal animals two things will be stained: (1) The nuclei of the smooth muscle cells in the media; (2) a fine network in the adventitia composed of fibers of sympathetic unmyelinated nerves (Fig. 1). There is a marked tendency for the stain to fade in a few weeks or months. Mounts are, therefore, seldom permanent, though an occasional slide will retain its color for years, it is said (one and a half years is the record in our collection). We have recently used neutral balsam in an attempt to remedy this defect, with only slight success.

In the animals operated on, under the anesthesia previously described, the right lumbar sympathetic chain was removed by the technic described by Bacq. The animals were then kept for 60 days and treated as the irradiated animals except that the two femoral arteries were carefully kept separate. In our hands, at least, this operation has a high mortality, only two of 15 animals operated on surviving the 60-day period. As it was done only as a check on the method it was not thought necessary to run another series.

Result.—In the 16 animals treated by irradiation no change from the normal in the sympathetic plexus in the adventitia could be found. In the two animals in which the right lumbar sympathetic ganglion chain had been removed, the adventitial plexus was normal on the left side, but entirely absent on the right. This latter is quite in agreement with reports by previous investigators, such as Busch.

SUMMARY

Ablation of sympathetic ganglia is known to be followed by degeneration of the sympathetic nerve plexus in the adventitia of the arteries they supply. This previous observation was confirmed after surgical removal of such ganglia. Irradiation of the same ganglia, in the dosage used (800 r), in white rats, does not effect a corresponding change, and the adventitial plexus appears to be unaltered. Therefore, subject to the limitation of the method, there is no evidence that roentgen irradiation permanently and organically alters or destroys the sympathetic ganglia.

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RADIATION THERAPY IN CARCINOMA OF THE BRONCHUS

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From the Radiation Therapy Department, Beth Israel Hospital: I. SETH HIRSCH, M.D., Director

IN preparing a report of the case of carcinoma of the bronchus here recorded, the present writer made a careful survey of recent literature upon the general subject of lung carcinoma. While he found abundant material, very little of this concerned therapy, and of the reports of treatment only few even mentioned other means than surgery. There was a very general agreement among all authors upon certain points, notably:

1. Carcincoma of the lung is not a very frequent type of the disease, but its incidence appears to be increasing.

2. The onset is insidious; it probably exists in an active state for a considerable time before any clinical symptoms are manifested, or any shadows evident on x-ray examination.

3. The diagnosis of primary carcinoma of the lung in its early stages is rarely (if ever) made, because of the insidious character of its onset.

4. The great majority of authors recommend surgery as the only possible means of treatment, although very few of them hold out any hope of surgical cure, or even relief, and those who report surgical cases admit a mortality never less than 50 per cent, and frequently much higher.

5. Most authors mention radiation therapy only to condemn it, but in three articles (those by Leddy and Vinson, Roberts, and Kernan), radiation is recommended, and case reports of its favorable use are included.

As the details of histology, pathogenesis, and clinical picture have been very fully discussed in the papers cited above, they will not be touched upon in connection with this report, the present discussion being entirely confined to treatment. To quote Allen and Smith: "The treatment to be recommended depends, of course, upon the extent of the growth at the time the definite diagnosis is made"—this in view of the universal agreement that diagnosis is never made until the lesion is far advanced. These same authors advocate a lobectomy "for tumors located well out in the periphery or midportion of a lobe," but add that, as Graham has already pointed out "the radical operation offers scant hope of cure at present because of the advanced stage at which the diagnosis is usually made." By direct reference to Graham's paper, I find he states that, "In all, there are apparently six cases in the literature in which a patient has survived for at least a year the surgical removal of the [lung] carcinoma. Two of these patients were operated on by Sauerbruch, one by Churchill, two by Edwards, and one by Allen and Smith. At the time of the publication of these respective reports one of these patients was still alive and well five years after operation, another one three years, and two for two years. In most of these cases one lobe of the lung was removed." This paper was published in February, 1934, and is the most recent on the subject of lung carcinoma I have been able to find.

In Graham's paper is a considerable discussion of the claims of radiotherapy as a treatment for carcinoma of the lung. He asserts: "It is a matter of the utmost importance that the question should be definitely settled whether or not treatment by either the roentgen ray or by radium has ever cured a single proved case of a primary carcinoma of the bronchus or lung. . .reports of the treatment of cases by this means should be made in such a way as to make the evidence incontrovertible." By "incontrovertible evidence" this author no doubt means a definite biopsy report of primary carcinoma, which

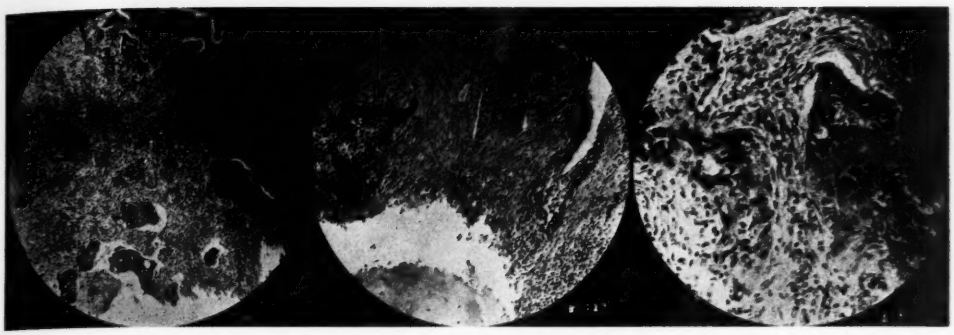

Fig. 1. Photomicrograph of specimen removed from right main bronchus, showing general invasion of squamous-cell carcinoma into the deeper structures of the bronchus. Magnification ×75.

Fig. 2. Photomicrograph of specimen removed from right main bronchus, showing typical squamous-cell carcinoma with tendency to pearl formation. Magnification ×150.

Fig. 3. Photomicrograph of specimen removed from right main bronchus, showing more detailed structure of squamous-cell carcinoma. Magnification ×300.

is not, of course, so readily obtained in cases in which radiation is used instead of the surgical removal of the growth. This author was unaware, or chose to ignore, that nearly as many cases of biopsied lung carcinoma treated by radiation are now living and free from symptoms, as those treated by surgery, which he enumerated as quoted above. Kernan, in April, 1933, reported a biopsy made on the lung of a 17-year-old girl, April 26, 1927, which the pathologist designated as "malignant tumor, probably carcinoma," and graded IV on Broders' scale. Immediately thereafter the patient received a course of high voltage roentgen treatments. "From then until the time of writing this article, she has been perfectly well, with no more bleeding and no pulmonary symptoms. Roentgenograms of her lungs, however, still show the same [tumor] shadow."

Including this case, Kernan observed nine patients suffering from histologically proved carcinoma of the bronchi or lungs who had been treated by x-ray, radium, and diathermy, although the last was not employed in all the cases. At the time his report was made, three were dead (33 per cent); four were well without any clinical symptoms or roentgenologic findings (44 per cent), and two were alive and well but still had suspicious shadows in the chest (22 per cent). All the patients had survived from three to five years since the conclusion of treatment.

In the series reported by Leddy and Vinson there were 42 histologically proved cases of bronchogenic carcinoma, treated by radium or roentgen rays. Ten of these patients, who received roentgen therapy alone, were living from fifteen months to four years after the diagnosis was made, the average duration of life for the entire group being twenty-three months.

Roberts, though presenting no cures, considers that x-ray treatment is justified in all cases too far advanced to be treated otherwise, because it is the best method of relieving severe pain and cough, even if life is not much prolonged. In his cases there was evidence of alleviation, re-expansion of the collapsed lung, and even temporary regression of the tumor.

In comparing the results obtained by surgery and those by radiation, we must not forget that surgery carries with it a primary hazard which is not connected with any form of irradiation. The figures for lobectomy done for benign conditions are interesting in this connection. Roberts and Nelson report two dead out of 10 lobectomized, or 20 per cent. Of Janes' 16 cases, five died—a 30 per cent mortality. As both of these reports concern

Fig. 4. Primary bronchial carcinoma taken Feb. 10, 1933, before x-ray treatment was instituted. There is present a localized atelectasis: the bronchial obstruction is not complete. The tumor appears to spring from the root of the right lung and is invading the basal portion of the right upper lobe.

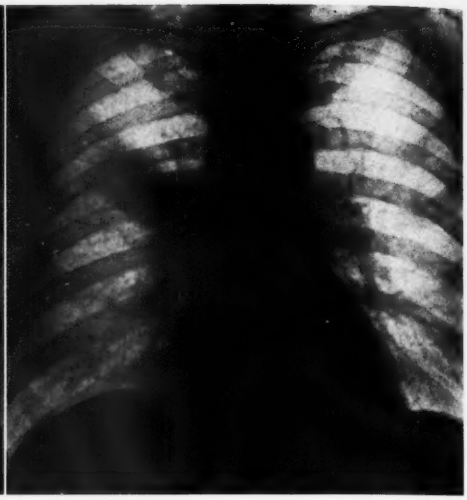

Fig. 5. Primary bronchial carcinoma taken March 3, 1933, early in the course of x-ray treatment. There is present an incomplete bronchial obstruction: the localized atelectasis is diminished. The tumor appears to be more circumscribed and shows considerable reduction in size.

benign conditions only (bronchiectasis), the question of metastasis by the dissemination of cancer implants did not have to be considered, as it must be when a malignant growth is removed by lobectomy.

The following case is presented as offering "incontrovertible evidence" of complete regression of a proved carcinoma primary to a bronchus, after roentgen therapy alone, the patient being symptom-free for twelve months after treatment was administered.

Carcinoma Primary to a Bronchus, Treated by Protracted Fractional Irradiation.—S. M., male, aged 52 years, referred to the Radiologic Service, Beth Israel Hospital, Feb. 20, 1933. By occupation a teamster, he also worked in a junk shop; moderate user of alcohol and tobacco. Pneumonia (?) four years ago; personal and family history otherwise negative.

Seven months before entrance, the patient had a cold which left him with a chronic cough, producing a thick, yellowish phlegm. Five weeks before entrance he was awakened from sleep by a sharp, "clutching" pain in the right anterior chest. At this time the pain lasted but a few seconds, but a week later it recurred, and though less severe, lasted for several hours. Twenty-four hours prior to admission the expectoration had become blood-stained.

In the general physical examination the thoracic findings were as follows: *Heart:* No shift nor cardiac dullness; apex in the fifth interspace. No murmurs; sounds of good quality. A2 greater than P2; rate, 84; blood pressure 120/90. *Lungs:* Left lung normal. Over right lung, upper lobe posteriorly, there are diminished resonance and breath sounds; anteriorly, the breath sounds are markedly diminished. Anteriorly, over areas of dullness there is increased transmission of the spoken voice. *Impression:* Partial atelectasis of upper right lobe, probably due to a neoplasm, with partial bronchostenosis.

Roentgenologic Examination.—Distortion of the shadow of the upper right hilum, associated with atelectatic changes in the

base of the upper right lobe, with slight pleural reaction. Roentgenogram suggests a primary bronchial carcinoma springing from the root of the right lung and invading a portion of the upper right lobe, without completely obstructing the bronchus.

Laboratory Findings were as follows:

Urine: Normal

Blood:	Feb. 9, '33	May 5, '33	Dec. 11, '33
Red cells	4,100,000	5,480,000	5,230,000
Hemoglobin	85%	100%	100%
White cells	8,300	5,800	5,600
Polymorphonuclears	73	82	76
Mononuclears	27	18	24
Abnormal forms	0	0	0

Sedimentation rate—50 min. (Feb. 9, 1933)
Venous pressure—3 cm. (Feb. 9, 1933)
Wassermann reaction—Negative.

Bronchoscopic Examination.—(Dr. G. W. Miller.) The mucous membrane of the right main bronchus is markedly congested. Underlying cartilaginous rings not transparent; hypertrophy especially noticeable in the lumen of the upper lobe bronchus. Specimen obtained for biopsy.

Biopsy.—Squamous-cell carcinoma of bronchus.

Treatment.—Roentgentherapy (protracted fractional irradiation) with the following set-up: Constant potential, valve-tube rectification; 200K. V.; 4 ma.; filtration, 2 mm. Cu and 1 mm. Al; distance, 60 cm.

The basic principle of treatment was to administer maximum irradiation to the tumor mass by cross-firing through three portals of entry, as well as by irradiation of the mediastinum and hilar glands. A regular daily treatment was given so long as the patient remained in the hospital. It was felt that the success of the therapy depended upon the high dosage and protracted fractional administration. Treatments were given as follows:

		Portal	Time total	Dose total
Feb. 21 to March 7, 1933 (13 tr.)	rt. ant. thoracic portal	11×13	585 min.	3744 r (288 r/day)
March 28 to April 12, 1933 (10 tr.)	rt. lat. thoracic portal	12×14	420 min.	2688 r (268 r/day)
April 13 to May 8, 1933 (12 tr.)	rt. post. thoracic portal	14×18	560 min.	3584 r (298 r/day)
			Total	10,016 r

It was also planned at the outset to give radiothermy treatments three times weekly, following the x-ray therapy. This was an attempt to increase the metabolism of the tumor, and perhaps influence the radiosensitivity of the malignant tissues. Nine such treatments were accordingly given between Feb. 27 and May 10, 1933, the resulting fever usually lasting seven hours. The maximum rectal temperature induced was approximately 103° F.

Progress.—Examination of the chest, one month after the institution of x-ray therapy, showed considerable reduction in the size of the tumor at the root of the right lung. A bronchoscopic examination two weeks previously—twelve days after treatment was begun—though reporting the upper right lobe bronchus narrowed, its mucosa infiltrated, and its carina reduced in diameter, nevertheless gave "an appreciable improvement over the previous findings."

Dose.—Each of three portals used received a maximum skin-toleration dose, producing erythema and pigmentation. May 1, 1933, x-ray examination showed no bronchostenosis and marked regression of the tumor mass, although infiltration was still evident at the root of the right lung, extending outward along the interlobar fissure, with moderate bilateral lymph node enlargement at the roots of the lungs.

Clinically there was no cough, no thoracic pain, and no blood-tinged sputum. The patient had gained ten pounds in weight, which was 195 pounds on May 1, 1933. Blood examination showed an increase in red cells and hemoglobin, and a decrease in leukocytes. The patient left the hospital and went to work.

Re-examined Aug. 3, 1933, the x-ray showed scarcely any evidence of infiltration at the base of the upper right lobe, though there was still thickening of the bronchial walls in this area. The weight was 196 pounds, and the general condition

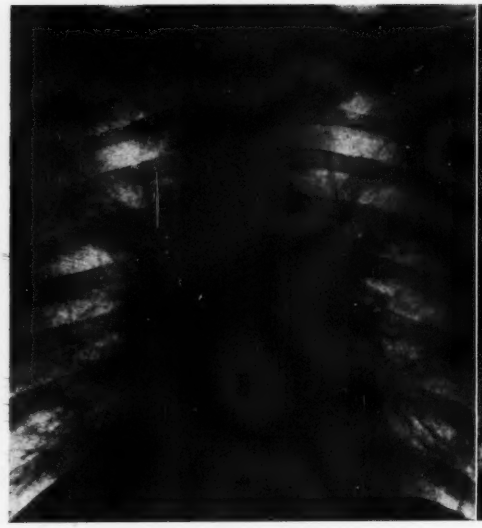

Fig. 6. Primary bronchial carcinoma taken May 1, 1933, at the end of the x-ray treatment of the right thorax. There is marked regression of the tumor mass: no bronchostenosis: area of atelectasis diminished.

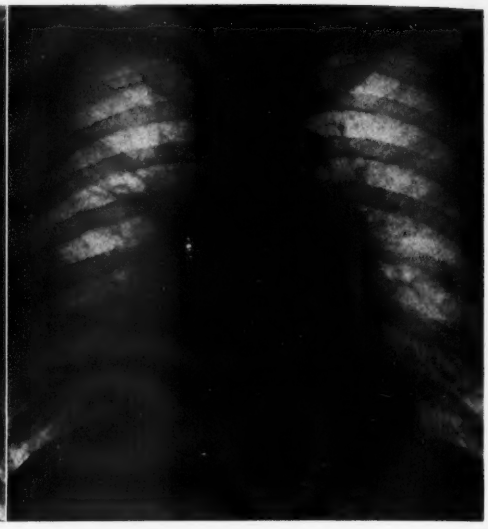

Fig. 7. Primary bronchial carcinoma taken Feb. 21, 1934, one year after beginning of the x-ray treatment. There is a complete disappearance of the tumor: no atelectasis and no bronchostenosis. There is some thickening of the bronchial walls of the primary and secondary root branches in the right upper lobe.

excellent. Further examination Dec. 8, 1933, showed no atelectasis, and considerable resolution of the carcinomatous infiltration, though some thickening of the bronchial walls was still in evidence. There was no metastasis in the left lung, or elsewhere; weight was 193 pounds.

Present Condition.—When seen Feb. 28, 1934, just before this paper was begun, the patient appeared in perfect health and absolutely symptom-free. His weight was 205 pounds. The x-ray inspection at this time showed the following: almost complete regression of the lesion at the root of right lung; hilum shadow very slightly distorted, particularly in upper part; small area of infiltration at third intercostal space, neither very dense nor sharply defined. "It is justifiable to deduce from these films that the major portion of the tumor has completely disappeared, and there now remains only some productive changes in the bronchial walls." When seen again on May 1, 1934, the patient was symptom-free and in excellent condition.

SUMMARY AND CONCLUSIONS

In the extensive literature now existing concerning carcinoma of the lung, most of the authors name surgery (lobectomy) as the treatment of choice. This choice is limited, however, by the opinion universally expressed, that only comparatively early cases are suited for lobectomy, and that the insidious nature of lung carcinoma makes early diagnosis practically impossible. Comparison of statistics also shows that lobectomy, when done for benign conditions, carries with it a high mortality (from 20 to 30 per cent).

Radiation by roentgen ray and radium has no immediate mortality. Many writers mention that even if life is not prolonged by radiation therapy, the patient's sufferings are greatly lessened, and what life remains to him is made more endurable. A number of isolated cases have been reported in which the progress of histologically proved primary carcinoma of the lung has been halted by radiation,

the patient remaining in good condition for some months—too short a time to permit any claims of permanent cure. Leddy and Vinson report 10 patients who, after having received roentgen therapy alone, are living and well from fifteen months to four years after the diagnosis. Kernan reports four patients without any evidence of carcinoma, and two clinically well but showing some remains of the lung tumor roentgenographically. As these represented 25 per cent of the first series and 66 per cent of the second, these results are certainly equal to those of surgery.

There would seem to be justification for the conclusion that irradiation is to be preferred in the treatment of lung carcinoma, as it offers greater possibility of cure in the early cases, for the following two reasons: (1) the indications for its use are much less restricted than those of surgery; (2) in advanced cases, beyond hope of cure by any means, it affords a far greater degree of palliation than can be otherwise obtained.

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THE TREATMENT OF CANCER OF THE MOUTH BY SURFACE AND INTERSTITIAL IRRADIATION[1]

By GEORGE E. PFAHLER, M.D., Sc.D., Professor of Radiology,
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AS is well known by all of you, we can lay down general principles as to the treatment of cancer of the mouth, but the individual who has cancer must be treated according to conditions present. A technic must be used which will destroy or remove all of the cancer and yet avoid as much as possible damage or destruction to the other tissues. To fulfill these requirements, it is unwise to be limited to any one special technic. At times, it is advisable to combine local surface applications of radium with external applications by radium packs, or with the more penetrating highly filtered roentgen rays. In those cases which are of long duration or in which there is much fibrous scar tissue, perhaps from incomplete treatment, it is often advisable to remove the remaining local disease by electrocoagulation.

As a general rule, it is my custom to begin the treatment of cancer of the mouth with radium packs or high voltage x-rays applied externally so as to control at the beginning the spread of the disease. This is followed almost immediately, however, by local surface applications of radium inside the mouth. These applications are applied usually on alternating days inside the mouth and externally, so that the patient does not become too much disturbed by one form of treatment. For the local applications, we use radium element covered by 2 millimeters of platinum, covered with 1 millimeter of rubber filtration for the applications within small crevices, but where space permits, this is increased by 2 millimeters of rubber, giving 5 millimeters in distance. The applications are made successively on all sides of the tumor area, so that all parts of the tumor tissue shall receive from six to ten erythema doses, counting the external irradiation.

The radium is applied in all possible positions to obtain a cross-firing effect on the primary lesion. For example, with a lesion on the posterior portion of the tongue, radium is applied to the base of the tongue, dorsum of the tongue, and in the floor of the mouth. Lesions in the anterior portion and margins of the tongue are irradiated by radium applications on the dorsum of the tongue and in the floor of the mouth. These surface applications are frequently supplemented by interstitial irradiation with platinum needles containing one, two, or three milligrams of radium element, and inserted preferably through the skin so as to avoid infection, and so distributed as to give uniform irradiation through the tumor area.

To make the local applications of radium for surface effects we use lead applicators 3 millimeters thick, which shield the surrounding tissues. These lead applicators can be adapted to every particular location and lesion, and must be prepared especially for each individual case, or each individual lesion.

For applications in the pharynx and about the posterior surface of the tongue, we use hollow tubes containing radium capsules which can be shaped to the curve of the pharynx.

We have not found the dental molds very satisfactory because they occupy too much space, and in our patients the cancer often interferes too much to allow opening the mouth sufficiently to introduce such dental molds. Furthermore, we have found that the dental compound does not give as much protection to the normal tissues in proportion to its thickness as does lead.

[1] Discussion before the Fourth International Congress of Radiology, at Zürich, Switzerland, July 23–27, 1934.

The lead applicators which we use are covered with a layer of 1 mm. of rubber.

In all cancers of the mouth we give our chief attention to the associated lymphatics. The local disease, if necessary, can be removed by electrocoagulation or, if conditions interfere with sufficient irradiation, by surface application; then interstitial irradiation can be used.

For interstitial irradiation we use radium element in needles containing one, two, three, and ten milligrams, each milligram being distributed in approximately two centimeters of needle length. The 3-milligram radium needles are 6 centimeters in length, and the wall thickness is 0.6 mm. of irridio-platinum. The 1-milligram and 2-milligram needles are covered with 0.5 mm. of irridio-platinum. The small quantity radium needles are used for prolonged irradiation, usually remaining in place about five days. I say five days instead of seven or eight days because we give in association surface irradiation, both inside the mouth and externally. The 10-milligram radium needles are made of monel metal, and have walls of 0.4 mm. in thickness. These are used when for some reason the smaller quantities cannot be used for a long period of time. I prefer the slowly and highly filtered irradiation, but, in certain cases, one must obtain the necessary irradiation effects in a short period of time. The 10-milligram radium needles are used particularly when we do electrocoagulation, and they are then inserted into the wound immediately and directed outward from the site of the former disease. These are usually left in place only four hours, and are placed approximately one centimeter apart. All local irradiation is supplemented by radium packs or high voltage roentgen rays.

Radium packs are made up with Columbia paste, or one may use felt pads or sponge rubber. We use from four to six centimeters distance. The units of 10 milligrams of radium element each are contained in 1 millimeter of gold and 1 millimeter of platinum, which is the equivalent of 4 millimeters of lead. From clinical observation I am convinced that a higher filtration gives a proportionately greater differentiation effect on the malignant tissue as compared with the normal tissue. In other words, I obtain a more satisfactory destruction of the malignant tissue and a better preservation of the normal tissues. The units are used in a proportion of about one milligram to each square centimeter and so arranged as to give a uniform irradiation to all parts of the tumor tissue. We commonly use 150 milligrams on the affected side, and 100 milligrams on the opposite side. These packs are left in place twenty-four hours, and are repeated two or three times a week until from 30,000 to 50,000 milligram-hours are used during from three to four weeks. This external radium treatment is supplemented by local applications of surface or interstitial applications of radium, and when necessary, by 200 K.V. roentgen irradiation, filtered through 2 millimeters of copper. Further details on technic are given in a recent communication.[2]

In the treatment of carcinoma of the lip we commonly destroy or remove the lesion by electrocoagulation and supplement this with high voltage irradiation over the lymphatic glands draining the area. When the lesion is large, so that one cannot accomplish this result without destroying the functions of the lip, then we attempt to control the disease of the lip by interstitial and surface applications or radium. However, in the small lesions, it is advisable to obtain a biopsy, and therefore, since there must be some traumatism for the purpose of taking a biopsy, I have concluded that it is better to remove the entire lesion, providing it will not cause too much deformity of the lip. In the early lesions, it causes practically no deformity. The results of treatment by the above technic are shown in the accompanying tables, which have been prepared for me by my associate, Dr. Jacob H. Vastine.

[2] Irradiation Therapy in Cancer of the Mouth: Technic and Results, G. E. Pfahler and J. H. Vastine. RADIOLOGY, January, 1934, **22**, 15-26.

TABLE I.—RESULTS IN 316 CASES OF EPITHELIOMA OF THE LIP

Treatment carried to a conclusion	294
Advanced and hopeless cases in which treatment was not advised	22
Total	316

CLASSIFICATION ACCORDING TO RESULTS OF TREATMENT

	Cases	Per cent
Living and free from evidence of disease (absolute cures all cases)	240	= 81
Dead from carcinoma	40	= 13
Well when last seen—not traceable now	14	= 6
Total	294	= 100
Omitting the 14 cases not traceable—but probably well. Recovery—85% Dead— 15%		

CLASSIFICATION ACCORDING TO EXTENT OF DISEASE

	Recoveries	Dead from cancer	Total
Local lesion, 1.5 cm. or less in diameter	159—98%	3— 2%	162
Local lesion, extensive, *i.e.*, more than 1.5 cm. in diam	53—79%	14—21%	67
Cases in which there were palpable lymph nodes	25—53%	22—47%	47
Post-operative irradiation given before recur	3—75%	1—25%	4
Total	240	40	280
Cases with no palpable lymph nodes	212—92%	17— 8%	229
Cases with palpable lymph nodes	25—53%	22—47%	47

CASES TREATED PRIOR TO JANUARY 1, 1929

	Well	Per cent well over 5 years	Dead from cancer	Lip well* dead from inter. dis.	Not traced	Total
Local lesions less than 1.5 cm. diam	107	97.2%	3	13	4	127
Ext. lesion more than 1.5 cm. diam	25	75.7%	8	9	2	44
Cases with palpable lymph nodes	7	26.8%	19	4	1	31
Grand total						202

* Not included in percentages.

TABLE II

Total treated by previous methods	181
Total treated by present technic	264
Total mouth cases treated	445
Total lip cases treated	294
Grand total	739

TREATED BY PREVIOUS METHODS

	Well	Per cent absolute 5-year recoveries	Dead from cancer	Dead from intercurrent disease	Not traceable
Tongue	27	28.5%	53	4	11
Cheek	9	28.1%	20	2	1
Tonsil	5	35.7%	8	0	1
Lower jaw	1	5.3%	13	2	3
Palate and pharynx	2	9.5%	13	1	5
Total	44	24.3%	107	9	21

TREATED BY PRESENT TECHNIC

	Well 5 yrs.	3 yrs.	Less than 3 years	Per cent absolute 5-year recoveries	Per cent absolute 3 year recoveries	Dead from cancer	Dead from inter. disease	Not traced
Tongue	16	5	6	26.2%	25.0%	76	1	2
Cheek	7	10	5	35.0%	44.7%	16	3	3
Tonsil	2	2	6	20.0%	22.2%	14	0	3
Lower jaw	6	3	2	25.0%	27.5%	22	4	2
Palate and pharynx	9	6	3	30.0%	35.7%	25	4	1
Total	40	26	22 = 88	27.6%	30.6%	153	12	11

Excluding cases which could not be traced and which died of intercurrent disease, there were: 30.7 per cent of 5-year recoveries by present technic; 33.8 per cent of 3-year recoveries by present technic.

The list of 5-year recoveries refers only to those cases which were treated more than five years ago; the 3-year recoveries refer only to those treated more than three years ago, and the others refer to those treated less than three years ago.

TABLE III.—MOUTH CASES WITH PALPABLE LYMPH NODES

Of 211 cases, 45 (21.3 per cent) well for varying periods.
Of 77 cases, treated prior to 1924 (old technic), 13 (or 16.8 per cent) are 5-year recoveries.
Of 55 cases, treated between 1924 and 1929 (newer technic), 15 (or 27.2 per cent) are 5-year recoveries.
Enlarged nodes in and about which radium needles were inserted for from 4 to 7 days = 24 cases, of which 10 are living and apparently well for periods of from

less than 1 year, 1 case;
1 to 2 years, 3 cases;
2 to 3 years, 3 cases;
3 to 4 years, 3 cases.

PRESENT METHODS OF TREATING NECK METASTASES BY RADIATION AT THE STATE INSTITUTE FOR THE STUDY OF MALIGNANT DISEASES AT BUFFALO, NEW YORK[1]

By BURTON T. SIMPSON, M.D., Director

THE State Institute was founded primarily for the purpose of research concerning the causes and the treatment of cancer and allied diseases. At the present time our therapeutic researches are chiefly concentrated on the radiation treatment of cancer to determine if possible, the exact rôle that irradiation plays in the treatment of this group of diseases. While we do not wish to enter into any controversy in regard to the relative merits of surgery, it is our opinion, based upon our observations, that in most cases radiation is the preferable method of treatment for metastatic deposits in the neck.

For treatment purposes we have at our disposal 7,770 milligrams of radium, distributed approximately as follows: four grams in a large pack, two grams in solution, ten tubes each containing 100 milligrams and seven tubes each containing 50 milligrams of radium salt, 165 cells each containing from 1 to 5 milligrams, which when placed in platinum needles may be utilized for implantation. We have also three x-ray machines of 200 K.V. capacity at 25 milliamperes.

The personnel consists of a surgeon, a radiotherapist, a physicist, and a pathologist, supplemented by other specialists interested in cancer therapy.

Our methods of radiation treatment have naturally been modified from time to time to meet the advances made in this type of therapy and also in accordance with our experiences. In the early days, large single doses were the rule. However, when it was found that more radiation could be introduced into the lesion by the divided dose method without injury to the skin, the single dose method was discarded and divided dosage introduced. Filtration experiments were carried on by our physicists and advancement was made along these lines. Many cases were treated by implantation of radon and needles containing radium salt, either alone or combined with external radiation.

It would be useless to go into detail concerning the methods formerly used. I should like, however, to describe a few cases, illustrating each of our methods of treatment of metastatic nodes in the neck.

IMPLANTATION (GOLD SEEDS OF RADON)

The first case, a male patient aged 68 years, had a squamous-cell carcinoma of the floor of the mouth, associated with a metastatic node in the right submaxillary region. Both the primary lesion and the metastasis were treated by implantation with gold seeds containing radon. The node received a total of 660 millicurie-hours. The primary lesion healed and the node disappeared. The patient has remained free from any clinical evidence of the disease up to the present, a period of more than six years. While we had no biopsy of this node, we were quite certain from the clinical findings that it was a true metastasis.

Notwithstanding the favorable outcome of the case cited, we have largely discarded the practice of implantation of metastatic nodes and use this procedure only in exceptional cases, for we believe that equally good results can be obtained by external radiation and thus avoid some of the undesirable effects of implantation.

EXTERNAL RADIATION—X-RAY

The patient, a male aged 73 years, presented a group of hard, sharply defined nodes in the peritonsillar region extending down the sternomastoid muscle, on the left side of the neck. Biopsy showed squamous-cell carcinoma. The patient was

[1] Presented before the Fourth International Congress of Radiology, at Zurich, Switzerland, July 24–31, 1934.

given eight daily treatments on the left side of the neck over a field 10 × 15 cm. at a distance of 50 cm. target-skin distance. The factors were 200 K.V., 30 milliamperes, with 0.5 mm. copper. The lambda effective was 0.16 Å. Calculation showed 277 r per dose, thus making a total of 2,220 r on the skin and a cumulative dose of 1,600 r, allowing a loss of radiation effect of 8 per cent per day. Two months after this treatment there was a complete disappearance of the metastatic nodes. Unfortunately, after a period of several months, there was recurrence in the radiated nodes and evident involvement of the nodes on the opposite side.

Experiences of this character convinced us that the effective dosage was insufficient and also that it was desirable to treat both sides of the neck, notwithstanding the fact that there were no perceptible nodes on one side. As a matter of fact, we are at present radiating both sides of the neck in all malignant lesions of the lip, tongue, mouth, pharynx, or larynx, whether or not there is evidence of metastatic involvement.

The following case history illustrates the type of treatment which we believe is more effective and will produce better results. It is the type of x-ray therapy which we are using at the present time.

The patient, a female aged 74 years, showed a metastatic node 3 cm. in diameter in the left submaxillary region following a surgical removal of a primary carcinoma of the larynx eight months previously. The treatment factors were as follows: 200 K.V., 30 milliamperes, with Thoreaus filter, the equivalent of 3 mm. copper. The field was 10 × 15 cm. at a distance of 50 centimeters. The left side of the neck was given ten consecutive daily doses, followed directly by four consecutive daily doses on the right side of the neck. With the Thoreaus filter the lambda effective is measured as 0.11 Å. The estimated daily dosage was 340 r, making a total of 4,100 r on the skin with a cumulative dosage peak of 2,340 r, allowing an 8 per cent loss of radiation effect for this wave length. There was marked diminution in the size of the node following treatment.

The period of time which has elapsed since we have adopted this method of treatment is too short to allow us to present clinical results.

RADIUM

For external radiation with radium we utilize either the "small" two-gram pack or the "large" four-gram pack.

Two-gram Pack.—The two-gram pack contains the equivalent of 2 grams of radium consisting of a combination of radium salt and radon: usually 1 gram of the element supplemented by a sufficient quantity of radon.

The primary filter consists of 1 mm. of platinum, 1 mm. of bakelite, with a secondary filter next to the skin composed of 1 mm. of copper and 1 mm. of aluminum. At 6 cm. distance this pack delivers 134 r per gram-hour, and at 10 cm. distance, 71.5 r per gram-hour.

The two-gram pack in split doses of 3,000 mg.-hrs. per day at 6 cm. distance for twelve succeeding days has caused the disappearance of metastatic nodes from intraoral cancer. A marked epidermolytic reaction is necessary in all cases.

A typical case illustrating our technic with the two-gram pack is that of a male patient aged 66 years, with a squamous-cell carcinoma on the floor of the mouth. There was a large fixed metastatic growth measuring 4 cm. in diameter located in the left submaxillary region. The primary lesion was treated by implantation of radon seeds, and the metastatic growth with the two-gram pack over a field of 5 × 5 cm. at a distance of 6 centimeters. Eleven treatments were given on successive days. The estimated daily dose was 402 r, giving a total dose on the skin of 4,430 r, supplemented by an additional 500 r received from the radon implanted in the primary lesion. This treatment was followed in about fifteen days by a marked epidermolytic effect on the skin, which subsided in seven weeks. Eight weeks after treatment, the primary lesion had

completely healed and the metastatic mass had entirely disappeared.

Four-gram Pack.—The "large" pack contains 4 grams of radium. The primary filter consists of 1 mm. of platinum, 1 mm. of bakelite, 1.5 mm. of steel, with a secondary filter next to the skin of 0.5 mm. of copper and 1 mm. of aluminum. At 6 cm. distance this pack delivers 86 r per gram-hour as measured with a thimble ionization chamber calibrated in roentgens for x-rays only. At 10 cm. distance the amount delivered is 50 r per gram-hour.

Our method of using the four-gram pack in the treatment of metastatic nodes in the neck is illustrated by the following case history. A female, aged 42 years, had a carcinoma of the thyroid gland with marked metastasis in the left side of the neck. She was given 17 consecutive daily treatments over a field of 10 × 10 cm. at 10 cm. distance, the total skin dose being 5,100 r. Allowing 4 per cent per day for loss of radiation effect, a cumulative dose of approximately 3,590 r was given. Five months after this treatment the metastatic growth had entirely disappeared.

A review of the literature dealing with results obtained in the treatment of malignant lesions which have already metastasized to the neck, leads us to be very pessimistic in regard to the ultimate outcome to be expected from the methods used in the past. Schreiner (1), in analyzing 309 cases treated at the Institute between 1912 and 1923, found no five-year cures in 53 cases which gave evidence of metastatic involvement of the neck. On the other hand, the same author (2), reporting upon results obtained in the treatment of cancer of the lip, was able to report 21 per cent absolute five-year healings in 38 cases which showed definite metastases. It is interesting to note that in the analysis of the lip series 20 per cent which were treated only locally at the time, developed metastatic nodes later. One may conjecture whether or not metastases from lip lesions react more favorably than do those from intra-oral cancer.

Utilizing the Thoreaus filter and thereby obtaining a decidedly shorter wave length with consecutive daily divided doses, first on the side farthest from the lesion, continued for eight to ten treatments, and then repeated on the side nearest the lesion, appears to us to be the method of choice at the present time.

We are convinced that a large percentage of lip and intra-oral cancer cases have established metastases which are not demonstrable. Therefore, we believe that all malignant lesions in these locations should have treatment over the lymph-bearing areas based upon the assumption that metastases are present.

The fact that we are able to salvage even a small percentage of these distressing cases should give us encouragement and lead us to hope that with improved technic we shall be able to present better results in the future.

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DIVERTICULUM OF THE DUODENUM[1]

By L. GRANT GLICKMAN, M.D., Roentgenologist, Veterans' Administration Facility, *Milwaukee, Wisconsin*

AS there is no symptom-complex by which a duodenal diverticulum can be recognized clinically, the clinician is dependent for such a diagnosis upon the roentgen ray. Since the first description of diverticulum of the duodenum, in 1710, by Chomel, only one hundred cases had been reported up to 1910. The condition was discovered prior to the latter date by postmortem, or unexpectedly at laparotomy, and was considered rare. From 1910 to 1915, a great number of cases were reported with roentgen-ray demonstration of these diverticula, and in 1913, Case first called attention to the diagnosis of diverticulum of the duodenum by means of the roentgen ray and the opaque meal. Since that time several cases have been reported in the literature from time to time, and their incidence varies from 0.09 to 7 per cent, depending upon the different sources.

Etiology.—Duodenal diverticula have been classified as congenital and acquired and these have been subdivided into the true and false types, the former showing all the layers of the intestine and the latter lacking the muscular layer. In the acquired type, the etiologic factor may be: (1) traction from without, as in gall-bladder disease; (2) localized defect in the musculature, with a resulting pouch formation; (3) pressure from partial obstruction below, with resulting pouch formation, and (4) trauma.

Symptomatology.—The condition is one which must be differentiated from right upper quadrant abdominal pathology and may closely simulate gall-bladder disease, peptic ulcer, pancreatitis, etc. The most common symptom is that of fullness or bloating and pain of a more or less variable degree. The pain may be localized in the right upper quadrant of the abdomen or may be present in the epigastrium. The pain has been described as sharp or crampy in character, having its onset from one to two hours after meals and lasting for a period of from one to three hours. It may or may not be associated with nausea and vomiting. Neither the giving of food nor alkalies render relief. The symptoms as a rule are vague and the patient may date his complaint over a period of from two to twenty years.

Diagnosis.—The diagnosis is usually made by means of the roentgen ray with the aid of an opaque meal. The demonstration of these diverticula depends upon the appearance of a more or less spherical shadow which can be seen to fill and empty from the duodenum. At times, an air bubble is noted within this shadow. Persistence of the shadow is noted after the stomach and duodenum are empty. The differential diagnosis will call for a distinction from calcified glands, biliary stones, renal stones, perforated gastric or duodenal ulcers, and dilatation of the ampulla of Vater. Repeated fluoroscopic examinations may be necessary to reveal the diverticulum, and the connection between the diverticulum and the duodenal bulb may be seen at such examination. The roentgenologic differentiation of the congenital and acquired type cannot be conclusive. Prolonged retention by the diverticulum favors the possibility of diverticulitis.

CASE REPORTS

Case 1. Patient is a white female, aged 35 years, who presents herself for x-ray examination, giving a history of vague abdominal pain with nausea and a

[1] Published by authority of Dr. Charles M. Griffith, Medical Director, Veterans' Administration, Washington, D. C.

previous history of an appendectomy and cholecystectomy eight months prior to the present examination. She states that "no improvement has been noted in my general health since the operation and I complain of the same things that I did before I was operated on." At that time, the patient dated her onset of complaint two years prior to the operation, with the chief complaint being distention in the epigastrium associated with a "sour stomach" and pains in the epigastrium which were seldom relieved by the intake of food or alkalies. The symptoms appeared in a cycle with a duration of three or four weeks and a remission of approximately a similar period of time. At times, abstinence from food would offer some relief to the abdominal pain. The general physical examination at this time is negative except for tenderness in the midline of the abdomen in and around the umbilicus; a scar is noted in the right upper quadrant of the abdomen (cholecystectomy).

The x-ray examination reveals no apparent pathology involving the esophagus or stomach. The peristalsis is normal and as the opaque meal leaves the stomach it passes normally through the duodenal bulb until the bulb is distended. Then upon pressure, the examiner forces some of the meal out of the bulb into the second portion of the duodenum and a portion of the meal is noted passing medially from the bulb into a regularly outlined "pocket." The remainder of the gastro-intestinal examination is essentially negative. Fluoroscopic examination at a later date revealed similar findings (Figs. 1–3).

Fig. 1. Case 1. Showing diverticulum of the duodenum.

Fig. 2. Case 1. Same as Figure 1, with diverticulum being completely filled.

X-ray Diagnosis.—Duodenal diverticulum. Surgical operation confirmed the x-ray findings and the diverticulum was reported to be situated between the duodenal bulb and the lesser curvature of the stomach (Fig. 2). The diverticulum was ligated and removed.

Case 2. Patient is a white male, aged 40 years, who gives a history of an appendectomy at the age of 28 and a herniotomy at the age of 29. He dates the onset of his complaint three years prior to the present examination, with the chief symptom being epigastric pain which comes on one to two hours after meals. This

pain is relieved at times by the intake of food and alkalies. Vomiting is present without nausea and the vomitus contains streaks of blood. No tarry stools have been noticed. The general physical examination is essentially negative except for tenderness in the epigastrium. A scar is noted in the right lower quadrant (appendectomy) and another in the right inguinal region (herniotomy). No masses or fluid are noted in the abdomen.

The x-ray examination reveals no apparent pathology involving the esophagus or stomach. The peristalsis is fairly active. The duodenal cap reveals a filling defect involving the lateral aspect and at the sixth hour a minute amount of barium is seen in the region of the duodenal bulb but apparently outside the normal tract of the duodenum—the head of the meal has reached the mid-point in the transverse colon and the colon is normally outlined up to this point. At the 24-hour examination the ascending colon and the first portion of the transverse colon are empty, while the remainder of the colon is normally outlined.

X-ray Diagnosis.—Duodenal ulcer associated with a duodenal diverticulum. Surgical operation revealed a large ulcer with a diverticulum of the duodenum just distal to the pylorus. The operation consisted of resection of the ulcer-bearing portion of the duodenum and distal third of the stomach. The stump of the duodenum was closed and the stomach anastomosed to the jejunum.

Fig. 3. Case 1. Recheck gastric examination showing retention within the diverticulum described at the end of six hours.

SUMMARY

1. The diagnosis of duodenal diverticulum depends chiefly upon the roentgen ray.

2. Two cases are reported in detail. The chief symptoms are fullness and bloating in the epigastrium, associated with a pain in the right upper quadrant of the abdomen or in the epigastrium, a pain which is not necessarily relieved by the intake of food or alkalies.

3. The differential diagnosis involves a consideration of gall-bladder disease, peptic ulcer, pancreatitis, perforated gastric and duodenal ulcer.

Case 1 clearly shows the difficulty which arises in the differential diagnosis of this condition when no x-ray procedure is carried out. Cholecystography makes possible an adequate diagnosis as to gall-bladder pathology and, had the patient had a cholecystogram or a gastro-intestinal examination prior to operation, the operation prior to the removal of the diverticulum (cholecystectomy) could have been avoided.

Case 2 reveals the acquired type of diverticulum.

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A POSSIBLE DEVELOPMENT IN ROENTGEN THERAPY

(TRANSFORMATION OF MERELY TRANSMITTED INTO ABSORBABLE ROENTGEN ENERGY)

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RECENTLY Hughes and Binz (1), reported certain experimental observations on the therapeutic use of nascent iodine in irradiation therapy. While their work represents only a preliminary observation, the potential possibilities of enhancing the value of irradiation therapy along the lines presented by the authors is great. We quote as follows:

"The idea was conceived to synthesize an organic, chemically stable iodine compound of low toxicity from which nascent iodine or an active chemical radical could be liberated by roentgen irradiation after its intravenous administration. The purpose was not to produce a compound whose secondary radiations would have a therapeutic value or enhance the value of the irradiation itself. It was proposed rather to obtain a chemically stable pharmacologically inactive compound *per se*, which, under the influence of external forces such as roentgen irradiation, might undergo activation of its chemical structure such as liberation of nascent iodine or an active chemical radical. In this manner it might become possible to control by external forces localized therapeutic effects after parenteral administration of therapeutically inert compounds."

This proposed experimentation should be of considerable interest, particularly if it is possible to liberate sufficient quantities of therapeutically effective but otherwise non-toxic innocuous compounds by the medium of biologically indifferent doses of roentgen energy.

In connection with this article by Hughes and Binz, we feel justified in suggesting thoughts and experimentations along somewhat different lines and certainly at variance with the present trend in roentgen therapy.

At present, there exists a rather dogmatic belief that improvement in radiotherapeutic results can be obtained only by the further reduction of the wave lengths of the applied energy, or technically speaking, by multiplication of the potentials applied to the roentgen tube plus a heavier filtration. This belief is doubtlessly founded upon the therapeutic benefits obtained by gamma radiation from radium. The attempts to obtain higher voltages on the roentgen tubes are an effort to synthesize the wave lengths of the gamma spectrum of radium. The mechanics are not known by which biologic results are obtained through gamma radiations.

The shorter the wave length of energy in this region of the electromagnetic spectrum, the greater the penetration, or, in other words, the less the total amount of energy absorbed. It is universally accepted that only the absorbed energy enters into a biologic reaction.

There is no question but that gamma radiation does enter into biologic reactions, and that roentgen radiation of wave lengths approaching those of the gamma region must, *per se*, be biologically active. The question resolves into a consideration of efficiency. With an increase of applied potential and consequent decrease of wave length, the percentage of absorbed energy decreases and hence the gross or "overall" efficiency decreases.

As has been previously stated, little or nothing is known on the mechanics of the reaction between gamma radiation and the resulting biologic matter. For this reason it is not possible to compute the efficiency of the absorbed energy in any specific instance. A prediction based on present knowledge may be made with the reservation of rights to change when the fund of information has been increased.

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It is assumed that gamma radiation is generated by nuclear changes in the atoms. Absorption of gamma radiation by nuclear changes in atoms has never been discovered, and consequently the following more logical explanation of this absorption is accepted. It is believed that the waves of gamma radiation strike the electrons in some of the electron shells and thus cause them to generate radiation. This phenomenon is known as "scattering" (plus a repeated Compton effect), and the primary radiation is thus degenerated in successive stages until such a time as the energy is absorbed. During these stages of degeneration the wave length is increased. By logical deduction it would be assumed that at some region of the electromagnetic spectrum there would exist a point of maximum absorption and consequently maximum reaction. This is true both theoretically and experimentally, but the use of radiation from this region presents the practical difficulties of transmission from the source to the desired point of utilization. It is a problem akin to that of finding a container for the universal solvent.

Since "scattering" and eventual absorption do take place, the optimum conditions are those in which the maximum penetration takes place to a certain point with a maximum absorption of biologically effective radiation at that immediate locality.

The desire to obtain such conditions is not new. Attempts have been made to increase radiotherapeutic effects by the introduction of relatively harmless substances to specific localities with subsequent primary irradiation in the hope of generating secondary radiations. A notable attack in this direction is that by Wintz in the iontophoresis of the pelvis with zinc and copper. Undoubtedly there was a time when it was considered feasible to transform short wave high penetration radiant energy into a more readily absorbable form, and this was attempted in the living human being for therapeutic effects. The idea is still theoretically correct and practically possible.

With the introduction of excretion cholecystography and pyelography we have at our disposal chemical substances of relatively high atomic weight which, when injected intravenously, reach a temporarily high concentration in the liver and kidney, respectively. An attempt would seem justified to utilize the passing concentration of these metallic compounds for effective transformation of short wave length energy into the more efficient but longer wave lengths. The secondary radiation thus generated may prove of sufficient intensity to provide a therapeutic measure in patients with chronic, resistant, renal or hepatic infections and possibly also with malignant neoplasms.

As a means of further concentrating or intensifying these secondary therapeutic radiations it is possible to use an additional agent in the form of a fluorescent substance such as eosine, quinine, mercury derivatives, etc. These materials have fluorescence known to be in the bactericidal regions of the electromagnetic spectrum; these radiations are readily excited.

Confining our suggestions to the iodine compounds since they are more or less in common use, it is interesting to note that the characteristic spectrum of iodine may be excited by wave lengths of above 34 K.V. The characteristic spectrum of iodine shows wave lengths of 0.4 and 0.3 Ångstrom units which are in the soft x-ray and Grenz-ray regions and hence readily absorbed by organic materials.

The release of nascent iodine found by Hughes and Binz is due to a photochemical reaction. The combination of a chemical bactericidal agent with a therapeutically active form of radiation is possible, and it is highly probable from the spectral knowledge available that the latter property will materially accelerate and enhance the former.

The fluorescence and secondary radiations of trypaflavin, acroflavin, mercurochrome, fluorescein, quinine, etc., are

excited throughout a wide primary spectral range with intensity peaks depending upon chemical constituency and the quality of the exciting radiation. The combination of the two qualities of radiation plus the possible photochemical effects seems promising in view of the work of Tappeiner and his pupils on oligodynamic effects.

It is to be hoped that the work of Hughes and Binz will be called to the attention of endowed institutions and those with adequate facilities to continue the work begun by these two physicians.

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THE RATE OF RECUPERATION OF HUMAN SKIN FOLLOWING IRRADIATION[1]

PRELIMINARY REPORT

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THERE are several methods by which external irradiation may be administered. These procedures can be divided into three fundamental types: massive, fractional, and saturation dosage.

By the massive dose method the maximum effect is obtained through the single exposure to radiation. In the fractional dose method the maximum effects are obtained by the gradual administration of small doses. The saturation method consists in maintaining for a certain time a biologic effect already present, by the addition of smaller doses.

In any method the effect upon the normal structures finally limits the amount of radiation that can be delivered; in particular, the effect on the skin is the most important because this structure usually receives the largest amount of irradiation. The skin is an obvious indicator of the degree of damage produced. The gradual fading of the reaction after treatment affords evidence that there is recuperation of the tissues from radiation damage. The rate of recovery in tissues is an important factor in all methods of rradiation. In this type of treatment each quantity of radiation delivered is a sufficient amount to produce an effect equal to that lost by recovery of the tissues over a given time.

A technic for maintaining irradiated tissues in a state of saturation was first described by Kingery (1) in 1920. He assumed that the rate of depreciation in radiation effect was dependent upon the concentration of bio-chemical products. That is, the rate of loss would vary directly as the concentration of some hypothetical decomposition product. As this concentration decreased, the velocity of loss would become less in direct ratio. This theory draws an analogy from the so-called "mass reactions" of biology and chemistry, which are characterized by a semi-logarithmic curve.

Kingery's clinical observations were conducted upon patients with skin diseases treated by unfiltered rays of a "soft" character. By experimentation he found that an initial 100 per cent erythema dose could be repeated in fourteen days. He further states that 50 per cent of an erythema dose may be added at the expiration of three and one-half days, and 75 per cent at the end of seven days. He illustrated the depreciation of a 100 per cent erythema dose by a semi-logarithmic curve, based upon the above findings.

Pfahler (2, 3) expanded this work, and determined the depreciation curve of radiation effect produced by rays of different quality. He found that "soft" rays produced a biologic effect which depreciated more rapidly than the effect produced by rays of a "hard" quality. Weatherwax (4) continued a similar study, and confirmed the work of Kingery and Pfahler. By employing a formula he also illustrated that elimination of some of the "softer" rays from a given quality of radiation by the use of filters decreased the velocity of loss in radiation effect.

Stenstrom and Mattick (5) made observations upon six cases of breast carcinoma treated by irradiation. The part to be treated was divided into two fields, a single 100 per cent erythema being given to the upper area, and a greater but divided dose being delivered to the lower field. They found that the erythema produced by a single treatment about

[1] Read before the Eighteenth Annual Meeting of the Radiological Society of North America, at Atlantic City, Nov. 28–Dec. 1, 1932.

equaled that resulting from a 140 per cent of an erythema given over a period of ten days, or 150 per cent given over fourteen days.

The observations of Stenstrom and Mattick are best considered with those of the other mentioned workers, by comparing the rate of depreciation in radiation effect found by each. It is necessary that the comparison be based upon effects produced by a similar quality of radiation. Pfahler and Weatherwax found that a radiation effect produced by rays of a mean wave length of 0.16 Å. depreciated 50 per cent in twelve days, but Stenstrom and Mattick found the same loss in eight days.

TABLE I.—COMPARISON OF THE RATE OF DEPRECIATION IN BIOLOGIC EFFECT PRODUCED BY RAYS OF A MEAN WAVE LENGTH OF APPROXIMATELY 0.16.Å

	25% loss	50% loss	75% loss
Pfahler, Weatherwax	5 days	12 days	24 days
Stenstrom and Mattick	3½ days	8 days	17 days

Not only do the findings of these observers show a rather wide variation in the rate of depreciation in radiation effect, but MacKee (6), and Hazen and Whitmore (7) also noted skin reactions of variable degrees in employing the saturation method of treatment. This indicates that tissue recuperation deserves further study.

For observations of this sort it is necessary to employ a biologic method, because physical measurements do not determine the degree to which tissues will react to any amount of radiation. Since the reaction can be seen in the skin, this tissue can be used as a biologic indicator. The biologic unit cannot be based upon the tolerance of the skin to radiation, because it is impossible to establish a definite end point; neither can the degree of reaction be used, because of the difficulty in measuring the amount of discoloration in different individuals. However, by employing the so-called threshold erythema these difficulties are lessened. By this means only the presence or absence of any reaction need be noted. The amount of radiation which will produce a desired percentage of visible skin reactions, and none in the others receiving the exposure, represents a threshold erythema dose. This has been defined as the amount of radiation which will produce a visible reaction in 80 per cent of the patients receiving the exposure within four weeks after the treatment, and no reaction in the remaining 20 per cent.

A logical approach to the problem of tissue recuperation from radiation effect seems to be the method employed by Stenstrom and Mattick. The reactions produced by single exposures were compared to those resulting from larger but divided doses. By this procedure they were able to estimate the quantity of radiation necessary to produce equal reactions in both single and divided doses. In comparing these two amounts of radiation as to quantity, and the interval of time between exposures, they were able to estimate the rate of depreciation of radiation effect in the skin.

An important refinement can be added to the above method by standardizing the degree of reaction by the use of a threshold erythema.

The experimental work for this study has consisted in determining the amount of radiation required to produce a threshold erythema by single and by divided doses. Patients were chosen at random from the various clinics of the hospital, and the skin on the extensor surface of the forearms used for the tests. A water-cooled 200 K.V. x-ray machine operating at 30 ma., with 0.5 mm. Cu plus 2 mm. Al filter, at a 50 cm. target-skin distance was used for all of the tests. The size of the skin field was 10 by 10 cm. on all of the patients. The output of the x-ray tube was measured at frequent intervals in order to deliver as accurate an amount of radiation as possible. Following the exposures the patients were observed at weekly intervals over a period of one

month. The presence or absence of a skin reaction was recorded according to the independent observations of two individuals. Doubtful reactions were considered negative.

RESULTS OF EXPERIMENTS

A total of 65 tests was made to determine the threshold erythema dose for single exposures. The amount of radiation delivered to these patients varied from 400 roentgens[2] to 550 roentgens. Among the 14 patients who received 500 roentgens, 72 per cent showed a positive skin reaction. The incidence of positive reactions was the same for the seven patients who received 525 roentgens, but was increased to 94 per cent of the 17 patients who received 550 roentgens. Therefore, since a threshold erythema dose represents an amount of radiation which will produce a positive skin reaction in 80 per cent of the individuals receiving the exposure, this dose must be between 500 roentgens and 550 roentgens, when administered in the manner described. If a larger number of patients had received 525 roentgens, this group might have shown a greater percentage of positive reactions than the one receiving the lesser amount of radiation. However, 525 roentgens may be considered within the limits of experimental error of the threshold erythema dose for single exposures of radiation delivered under the conditions previously specified.

TABLE II.—PERCENTAGE OF POSITIVE SKIN REACTIONS FOR DIFFERENT AMOUNTS OF RADIATION DELIVERED IN SINGLE EXPOSURES

	Number of roentgens at each exposure						
	400	425	450	475	500	525	550
Number of Tests	6	2	13	6	14	7	17
Per Cent Positive	33	50	70	50	72	72	94

[2] Whenever roentgens are mentioned in this article, it is understood that the measurements were in air.

In determining the threshold erythema dose for divided doses, two exposures of equal amounts of radiation were given at a 24-hour or 48-hour interval. A total of 52 tests was done with an interval of 24 hours between the two exposures. The doses these patients received varied from 300 roentgens at each exposure to 425 roentgens delivered at each treatment. Among the 27 patients who received 375 roentgens each time, 70 per cent showed positive skin reactions. In those who received 400 roentgens twice, 77 per cent had positive reactions, while all of the four patients to whom 425 roentgens were delivered at each of the two exposures developed a visible reaction. Therefore, the threshold erythema dose for two exposures of equal amounts of radiation given 24 hours apart is 400 roentgens at each time.

TABLE III.—PERCENTAGE OF POSITIVE SKIN REACTIONS FOR DIFFERENT AMOUNTS OF RADIATION DELIVERED IN TWO EQUAL EXPOSURES 24 HOURS APART

	Number of roentgens at each exposure					
	300	325	350	375	400	425
Number of Tests	1	1	6	27	13	4
Per Cent Positive	0	0	33	70	77	100

Thirty-five tests were done to determine the threshold erythema dose for two exposures of equal amounts of radiation given 48 hours apart. The dose delivered to these patients at each exposure varied from 375 roentgens to 450 roentgens. Of the 14 patients who received two exposures of 400 roentgens each, 72 per cent showed positive skin reactions. Among the eight patients to whom 425 roentgens were delivered twice, 88 per cent were positive, and all of the nine patients who received two exposures of 450 roentgens developed a visible reaction in the irradiated skin. Very little difference was found in the amount of radiation required to produce a threshold erythema by two equal doses given 24 hours apart, and those given at

an interval of 48 hours. If 400 roentgens, or 425 roentgens were delivered to the skin, and the same area irradiated with an equal dose 48 hours later, about 80 per cent of the individuals who received the exposures showed a skin reaction. It seems reasonable to believe that a slight increase over the dose required to produce a threshold erythema by two exposures given 24 hours apart would be necessary if a 48-hour interval were used. Two exposures of 425 roentgens each have therefore been taken as more nearly representing the threshold erythema dose when administered 48 hours apart.

TABLE IV.—PERCENTAGE OF POSITIVE SKIN REACTIONS FOR DIFFERENT AMOUNTS OF RADIATION DELIVERED IN TWO EQUAL EXPOSURES 48 HOURS APART

	Number of roentgens at each exposure			
	375	400	425	450
Number of Tests	4	14	8	9
Per Cent Positive	75	72	88	100

DISCUSSION

When the effect produced by single or multiple exposures is the threshold erythema, the degree of skin damage may be considered the same in both instances. When two treatments were used, each of the exposures was less than the amount of radiation required to produce a threshold erythema by a single dose. Therefore, the reaction produced by the divided doses may be considered to be due to the effect of the second exposure added to that which remained from the first.

The amount of radiation effect remaining after 24 hours is unknown, and, even if it were known, the effect could not be expressed properly in terms of roentgens. However, such an expression may be used in order to estimate the tissue recovery. If 400 roentgens delivered to a skin area, which had received the same dose 24 hours earlier, produces an effect equal to that resulting from a single exposure of 525 roentgens, then the effect of 400 roentgens must have been added to a residual radiation effect which presumably would be produced by 125 roentgens. If this amount of equivalent radiation effect remains from the first 400 roentgens, the skin may be said to have recovered from 69 per cent of the damage resulting from the first exposure. By similar deductions from the data acquired on the 48-hour-interval tests, the recovery from the first exposure in this group must be 76 per cent.

This estimation of tissue recovery pertains only to the first exposure in the divided dose tests. That is, it pertains to the recovery occurring from an exposure of 400 roentgens and 425 roentgens at the end of 24 hours and 48 hours, respectively. This does not mean that the rate of recovery would be the same for greater doses, or different qualities of radiation, nor does it mean that the recovery from each dose would continue at the same rate over a protracted period of treatment with small doses.

One possible explanation of these data would be that a considerable percentage of recovery of normal skin takes place within 24 hours after exposure to radiation and then slowly at an unknown rate over an undetermined time. If, for example, an area of skin was being irradiated daily, the recovery from each dose might progress rapidly up to a certain point, but every exposure would add to the more permanent damage, which would accumulate more rapidly than recovery would take place. Also, large doses delivered in one exposure may produce a proportionately greater amount of the more permanent damage, so that the immediate recovery would be a lower percentage than occurs in smaller doses.

Further experiments will be done to determine the threshold erythema dose for various intervals between exposures, and for a greater number of treatments. Until this has been done no statement can be made upon the rate of tissue recuperation over a long protracted period of treat-

ment. However, the rate of tissue recuperation during the first 24 and 48 hours of treatment, with small exposures, appears to be more rapid than has been estimated by other authors. If tumor tissue recuperates at a less rapid rate than normal structures, the saturation technic of irradiation should prove to be a very desirable method of treatment.

SUMMARY AND CONCLUSION

1. Tissue recuperation has been studied by determining the quantity of radiation necessary to produce equal skin reactions in single and divided doses of 200 K.V. x-rays filtered by 0.5 mm. Cu and 2 mm. Al, using the threshold erythema as a standard reaction for comparison.

2. The threshold erythema dose for a single exposure, given under the condition described, is 525 roentgens.

3. The threshold erythema dose for equal amounts of radiation given at an interval of 24 hours is 400 roentgens for each exposure.

4. The threshold erythema dose for equal amounts of radiation given at an interval of 48 hours is 425 roentgens for each exposure.

5. The skin recovered 69 per cent of the immediate damage in 24 hours, and 76 per cent in 48 hours.

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THE ROENTGEN ASPECT OF GASTRIC ULCER THERAPY

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SINCE Haudek introduced the barium method of gastric examination and found what is now called the Haudek niche, the diagnosis and treatment of gastric ulcer has changed entirely. The surgeons first took command of the field and soon some type of operation was done in every case showing a niche. However, we need not go into the details here of the results of gastro-enterostomy. Undoubtedly many cases were cured, but we cannot forget the frequency of recurrent gastric ulcer, jejunal ulcer, the primary mortality, and the later morbidity, which resulted in the evidence that gastro-enterostomy was not satisfactory for every case. More recently gastric resection has been proposed. Certainly, it seemed logical that the removal of the acid-forming area of the stomach would prevent any recurrence, but here again the occurrence of jejunal ulcers and the primary mortality of the operation make one hesitate to recommend it for every case.

It became evident to the workers in the field of gastric ulcer that each case had to be studied individually and that no one treatment would do for all cases. In looking for a means of studying the lesions more carefully the roentgenologist was called in to help. Here again is another instance in which, because of the close co-operation between the clinician and the roentgenologist, therapy was placed upon a logical and scientific basis. It is this comparatively recent development in which we are interested in this discussion. We believe that a careful roentgenologic study of the gastric niche will reveal upon repeated examinations the stage and course which the pathologic process is taking.

Every gastro-enterologist has met with a case in which a definite roentgen diagnosis of gastric ulcer niche was not corroborated at operation, which was performed after several weeks of rest in bed. These cases, until very recently, were unaccountable. As late as 1927, Wright (1) reported cases of gastric hemorrhages with symptoms of gastric ulcer in which the x-ray findings were negative, after rest in bed. He concluded that these cases were as yet unexplainable: other authors have given various explanations for this phenomenon. Carman believed that a small niche could be entirely hidden by a distended stomach and urged the examination of the partially filled stomach. The report of Bassler and Lutz (10) is much more disconcerting. They believe that the case of the vanished niche was never a case of gastric ulcer. In their report they call attention to the long-standing immobile peristaltic contraction which is frequently diagnosed as an ulcer niche. Haudek himself reports several cases in which he found great difficulty in differentiating a niche from a peristaltic wave: he was unable to account for such cases. Our own experience coincides with that of Cole and Stewart. We believe that a definite niche is pathognomonic for an ulcer, and further that the disappearance of this niche at the end of two weeks in no way discounts the validity of the original diagnosis.

This conclusion is arrived at in the light of the newer conception of the pathology, which is centered around the work of Franklyn White (7) and others. The former, writing in 1927, believed that the sudden disappearance of the ulcer niche could be explained by actual reparative processes. By operative and postmortem findings he was able to show that rest in bed would start rapid healing in the ulcer. In some of his cases, loose granulation tissue filled the niche after two weeks' rest in bed. Caylor (11), of Rochester, writing in 1926, divided the reparative processes into the following:

1. The early cone-shaped niche;
2. The chronic plateau-shaped niche;
3. The healed stage with a pale pink scar.

He quoted one case in which rest in bed for one week made the niche disappear, only to reappear again after a sudden hemorrhage. He explained the clinical course in the following manner and illustrated it by slides. The first rapid disappearance of the niche was due to the rapid accumulation of loose granulation tissue; by means of food trauma some of this granulation tissue was broken off, causing hemorrhage. At this time the niche again became visible, although smaller. A cure is not present until epithelium has grown over the crater. These are the experiences of only two authors, though similar findings were reported by such reputable men as Cole (10), Stewart (10), Haudek, and Hamburger (6).

This, in our opinion, accounts for some of the cases in which the surgeon fails to find the gastric pathology. Such failures could be easily obviated, however, by repeated x-ray examinations, particularly the day before the operation. If the niche is still present at this time, the surgeon should be able to locate it. However, it is essential that the surgeon be adept at gastric surgery. A surgical report of "no pathology found" does not necessarily discount the x-ray findings. We are convinced that the inexperienced surgeon will occasionally overlook gastric pathology: we have reason to believe that the palpating finger of the inexperienced surgeon may sometimes be less dependable than the eyes of a well-trained roentgenologist.

It can be seen that some gastric ulcers can heal very rapidly. It remains only to develop some means of determining the type of the pathologic process and the reaction to the treatment. Wright, Kunstler (12), Crolin (3), Forman (2), and many other workers have studied this phase of the subject and have come to the conclusion that a course of medical treatment is particularly indicated in the following cases:

1. Patients under 45 years of age (patients older may respond, but as a rule not so readily).
2. Cases with history of short duration, and with attacks of short duration and long normal intervals.

It is fairly well agreed that obstruction, perforation, and some cases of bleeding need immediate surgical treatment. It may be mentioned here in passing, that hour-glass contraction *per se* is not an indication for operation. When the case of the chronic indurated gastric ulcer is brought up, there is some difference of opinion as to the proper course of procedure. While most clinicians are of the opinion that such cases are slow to react to medical treatment, we believe with Forman (2) that well-carried-out medical treatment is indicated before surgery. Crolin (3) says that in his experience chronic ulcer with perigastric pathology is difficult to heal medically. H. Singer, in a verbal report from his enormous amount of material at the Cook County Hospital, states that at least 75 per cent of these chronic indurated ulcers heal with medical treatment.

The internist must remember that in not immediately operating on gastric ulcer, he is assuming a great responsibility. He must be thoroughly capable of judging the course of the ulcer while under treatment. It is in just this phase of the treatment that roentgen studies are of paramount importance. The well-trained roentgenologist is not satisfied with a mere report of a gastric niche: his responsibility to the internist goes farther than that. He must be able to answer such questions as: "Is the ulcer in question penetrating?" "Is it healing?" "Is it likely to heal?" "What chance of rupture is there?" We can now, by repeated fluoroscopic examination, make an attempt to answer the above questions by means of certain findings. We may not always be right, but we should make the attempt. An acute penetrating ulcer may show one or all of the following findings:

1. A cone-shaped crater which is small,

about 0.5 cm. in length, along the lesser curvature and 0.5 cm. in depth into the perigastric tissues. The shape of the niche is significant: in our opinion a cone-shaped niche indicates active penetration and must be carefully watched.

2. Acute tenderness and rigidity of the abdomen are frequently present. The tenderness, however, is dependent upon the degree of penetration and peritoneal involvement. Frequently when the penetration is slight and the peritoneum is not involved the tenderness is absent. It is just this type of gastric ulcer that is so frequently missed in fluoroscopic work. For this reason, we have made it a rule to take multiple plates in all cases which are negative in the fluoroscopic examination. Frequently such a small acute niche is seen only in the plates.

3. Fixation of the stomach is rarely seen in acute gastric ulcers, because of the lack of peritoneal reaction. The stomach is easily distended and freely mobile. As we shall see in chronic ulcers, this finding is extremely important in judging the possibility of rupture.

4. Changes in the mucous membrane. In the acute ulcer there is no demonstrable change in the roentgen studies of the rugous folds. It is true that occasionally, if the ulcer lies on the posterior wall, the edema may show a very slight spreading of the adjacent rugæ. This is very rare, however, and is not seen in the acute lesions of the lesser curvature.

5. Incisura. It is surprising how frequently this important sign is absent in acute cases. This can certainly be taken as indicating a lack of involvement of the circular fibers of the true muscular layers. In our own experience, we have rarely seen a definite incisura in small acute ulcers.

6. Peristalses. In our experience peristalses were hardly affected by small acute ulcers. For the most part the peristalses were increased in frequency and depth and passed through the ulcer area with only slight decrease in intensity and depth.

7. Pylorospasm is frequently present, and in the absence of the duodenal ulcer should stimulate one to a very careful examination of the lesser curvature.

The small acute ulcer may either become chronic or go on to the healing stage. The chronic ulcer differs from the acute ulcer in the following ways:

1. The Niche.—This enlarges gradually and may reach the size of a quarter and even larger. Years ago Carman stated that niches approaching the size of a quarter were practically always malignant in nature: our own experience does not confirm this dictum. In our series, we had two cases presenting niches larger than a quarter. We were convinced that these were not malignant because under medical treatment instituted by Dr. Harry Singer at the Cook County Hospital, these cases showed a definite decrease in size of the niche. However, we believe that such large ulcers must be carefully watched and repeatedly examined. If progress is not seen within four weeks, surgical intervention is indicated, even though the roentgen findings do not show evidence of malignancy. The chronic ulcer is of the typical "plateau" type (Fig. 1) due to the peritoneal reaction and its resistance to further penetration.

2. Tenderness.—This is practically always present and at times so severe that the patient collapses during the examination: a frequent occurrence in our experience. A word of warning might be given here in regard to palpation in such cases. We are convinced that vigorous massage of the stomach in these cases will occasionally cause rupture. In one of our cases, showing a large chronic ulcer niche, rupture occurred several hours after the fluoroscopic examination. While this does not prove that the palpation caused the rupture, the evidence points strongly to such a conclusion. One certainly must be exceedingly careful in such cases, particularly when palpation is performed with a heavy lead glove or with a wooden spoon. We are now palpating such cases with the bare hand only.

3. Fixation.—When the chronic ulcer

Fig. 1. Case 1. Gastric ulcer with niche subacute. Conical plateau type. No incisura.

Fig. 2. Case 1. Six weeks after treatment, niche decidedly smaller.

reaches the size of 1 cm. or more it is practically always fixed by the peritoneal reaction around it. Palpation will reveal distensible tissue around the niche: when the niche is well on the lesser curvature and favors the posterior wall the peritoneal reaction is marked. Rarely is the niehe on the anterior surface where the protective elements are considerably decreased. For this reason, such ulcers are particularly prone to rupture.

4. Rugous Folds.—Changes in the rugous folds are frequently marked. Convergence of the folds, due to a contracting process, is common and always indicates a long-standing lesion. These converging rugæ must not be mistaken for the irregular, distorted, and broken rugæ of the ulcerating carcinoma.

5. The Incisura.—This is very frequently found in chronic ulcers. At times the greater curvature is in contact with the lesser curvature, causing the spastic hour-glass contraction. Occasionally this hour-glass contraction is due to massive infiltration, fibrosis, and secondary contraction from the ulcerating process. An exact study of the rugous folds, when possible, will frequently reveal the true nature of the incisura. If one can demonstrate normal rugæ in the region of the incisura, one can safely diagnose spastic incisura: if the rugæ are considerably distorted, organic stricture is the more likely. Since treatment depends considerably upon this differentiation, one should not hesitate to repeat the examination before making a decision.

6. Peristalses.—Here chronic and acute ulcers differ considerably. Peristalses, characteristically, do not pass through the large plateau type niche. This "skipping" of the peristalses definitely points to deep penetration of the muscular layers of the stomach.

7. Pylorospasm.—This is present as in acute ulcers, but apparently no more frequently and offers no additional information.

There now remains the roentgen findings in the healing ulcer. These are very definite indeed and form the objective bases

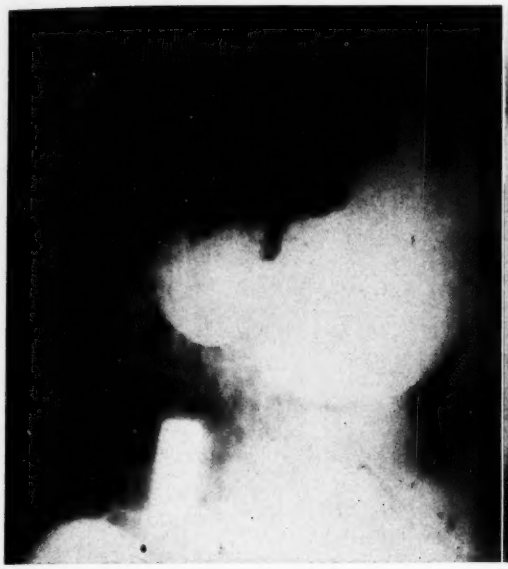

Fig. 3. Case 1. Twelve weeks after treatment. The niche had disappeared. Slight "skipping" was still present. Not a complete cure.

Fig. 4. Case 2. Large gastric ulcer, under suspicion of malignancy because of size. Note, however, adjacent rugæ which appear slightly distorted but not broken.

for checking the effect of the medical treatment. If the treatment is fortunate, the niche becomes smaller: it is surprising how rapidly this change may occur. In some of our cases, definite improvement was noted at the end of two weeks. We are of the opinion that if no improvement at all is noted at the end of six weeks, the treatment is not likely to succeed. As the niche grows smaller, tenderness decreases and is a good indication of diminished peritoneal reaction. The rugous folds, if they have not been previously distorted by contracting processes, gradually return to normal thickness. If considerable fibrosis has taken place the converging rugæ will remain as evidence of the previous ulcer, even though the niche can no longer be seen. In our experience, such converging rugæ should not lead to a diagnosis of ulcer without evidence of a niche or other roentgen signs of activity. The incisura gradually decreases in depth, and, as complete healing sets in, finally disappears entirely. As healing progresses, the peristalses return to the involved area. We believe this a good criterion of complete cure. In our experience, complete cure should not be diagnosed until normal peristalses are seen passing through the region of previous "skipping." In cases of large niches with evidence of contraction and fibroses, peristalses do not return completely. There frequently remains a decreased intensity in the region of the previous "skipping."

It has been said that food may enter into a niche and obscure the findings, but in our experience this has not occurred. In order to prove this point, patients with known gastric niches were given soft food and immediately examined with barium. In a series of 15 cases examined in this way, barium never failed to outline the entire niche after very slight manipulation. However, the possibility of food filling the niche must be considered. In cases in which a gastric ulcer is suspected and not found, the examination should be repeated and the lesser curvature gently massaged.

Fig. 5. Case 2. Two months after treatment. Niche is much smaller. Without question, it is a benign lesion.

Fig. 6. Case 3. Gastric ulcer niche. Large size points to malignancy. Decided for therapeutic test first.

We have not meant in our previous statements that one should rely on x-ray findings alone in judging the course of the ulcer: on the contrary, symptoms are of great importance. This much is true, however; symptoms may be relieved without appreciable improvement in the gastric niche: such cases are to be watched very carefully. If symptoms disappear and the niche does not decrease in size, we believe that an exploratory operation is indicated. No one sign may be ignored and the treatment must rest upon both clinical and x-ray findings. The results of medical treatment have varied somewhat with different authors: this is a natural outcome considering the many types of ulcers. Forman (2) reported 42 per cent of the cases well or improved after leaving the hospital. Nielson (4), in 1923, had followed up his cases for 22 years. Acute and recurrent gastric ulcers showed a 60 per cent cure. Chronic, so-called indolent ulcers showed results in only 9 per cent. In Franklyn White's series of cases of persistent ulcer craters in patients over 45 years of age, 50 per cent of the ulcer craters disappeared within two months. Dr. H. Singer, of the County Hospital, Chicago, verbally reported a 70 per cent cure in cases of so-called chronic indolent ulcers.

While the advantages of successful medical treatment of gastric ulcer are self-evident, the dangers are not to be denied. First comes the question of rupture while under treatment. Jordan (5), writing in 1925, states that he had no difficulty in judging the imminence of rupture of the ulcer. He contends that after two weeks of proper treatment, the niche should get smaller, and at the end of a month it should entirely disappear. This, in the main, has been his experience at the County Hospital as well as the experience of most of the workers in this field; but it cannot be too greatly emphasized that the repeated examination of the stools and fluoroscopic examinations are essential

in ruling out further penetration of a gastric ulcer. We have found it necessary to fluoroscope the patient every ten days during the first month and we believe that changes will be noted during such intervals in practically every case. The other condition that is so greatly feared when operation is not immediately performed is the possibility of the lesion becoming malignant. Here, statistics are certainly conflicting. At the County Hospital they have never seen a definite case of cancer developing at the site of an old ulcer. On the other hand, they have sufficient evidence to support the theory that such cases were carcinomatous from the onset and later degenerated, causing ulcers. Here are some of the statistics showing the percentage of gastric carcinomas containing evidence of previous benign lesions: Finsterer, 21 per cent; Ewing, 5 per cent; Aschoff, rare; Wright, very rare; Crile, less than 5 per cent; Mallory, never has seen it; McCarthy, at the Mayo Clinic, claims to have found evidence of a previous ulcer in 71 per cent of the carcinomas of the stomach. But the question is not as important as it may seem. While supporting the medical treatment, we still say that should the ulcer niche not decrease in size in response to treatment, an operation must be considered at the end of four weeks.

It has been our custom to urge operation even at the end of three weeks in cases in which the x-ray findings were not entirely typical of benign ulcer. Obviously, a carcinomatous ulcer would not decrease in size so that for all practical purposes the x-ray will indicate the necessity of operative procedure. Our series includes 20 patients with gastric ulcers of varied types: five cases were followed through to complete healing as demonstrated by the return of normal peristalsis: eleven cases left the hospital after several weeks' stay with a definite decrease in the size of the niche: two cases of large, chronic, indolent ulcers left the hospital improved at the end of three weeks—they showed no appreciable decrease in the size of the niche. Operation was urged but refused by the patients. Two cases were operated upon. One was a ruptured ulcer apparently caused by a too vigorous examination, and the other was a chronic indolent ulcer which showed only a slight reaction to treatment, and in a case in which the economic circumstances of the patient demanded an attempt at quick relief.

Fig. 7. Case 3. Eight weeks after treatment. Unusually rapid disappearance of the niche. Unquestionably, a benign lesion.

In conclusion we should like to emphasize the following:

1. Each case of gastric ulcer must be studied individually and treatment started according to the type of ulcer, behavior of the lesion while under treatment, and the age and condition of the patient.

2. The old idea of immediate operation is not supported by our present experiences.

3. The roentgenologist must be prepared to give fairly accurate data as to the pathologic stage of the ulcer and must not be satisfied with merely diagnosing its presence.

4. A careful roentgenologic examination should, in most cases, indicate whether the ulcer is acute, chronic, penetrating, or inactive.

5. The absence of a niche at operation after several weeks of rest in bed does not indicate an error in diagnosis. A niche

can heal very rapidly and be entirely absent at the end of four weeks.

6. Palpation should be done very carefully when a niche is visualized, because of the danger of traumatic rupture.

7. The close co-operation between the internist and the roentgenologist is urged in the best interest of the patient.

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EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

ABUSE OF THE FLUOROSCOPE

The fluoroscope is an indispensable piece of x-ray apparatus, and when used by a roentgenologist it renders valuable diagnostic information. However, it may be considered one of the most hazardous of all x-ray apparatus. When reports of x-ray burns were frequent, the fluoroscope accounted for a large portion of them. This was particularly true in the instances wherein the roentgenologists suffered burns. Thus it is well known to the radiological profession that the use of the fluoroscope is attended by a certain danger, even in the hands of experts, and has a distinct limitation to certain x-ray diagnoses.

Our attention has been called to a monthly review, issued by the National Tuberculosis Association (May, 1931, **14**, No. 5), in which there appeared a lengthy presentation on the importance of the fluoroscopic examination in suspected cases of pulmonary tuberculosis.[1] In order to fortify their situation, and impress their readers with certain arguments in favor of the fluoroscopic examination, they present an elaborate reference to foreign contributors. We are all familiar with the ease with which patent medicine people and others can obtain recommendations of their products by European physicians; some of these foreigners are very obliging and enthusiastic with their statistics. For instance, the author from whom the National Tuberculosis Association quotes as having used the fluoroscope in the diagnosis of pulmonary tuberculosis says that he himself "has examined 4,836 students of both sexes with the following results: Inactive lesions, 14.8 per cent; partially active lesions, 1.3 per cent; active closed lesions, 0.17 per cent; open lesions, 0.39 per cent; total tuberculous lesions found, 16.66 per cent."

It should be explained that at the time this survey was made the financial status of the European peoples was bad, and every economical measure was resorted to. Since the fluoroscopic method of examination was much less costly than the use of films, the former method was adopted. This is the only reason we can see why such a procedure was followed.

It would appear that the National Tuberculosis Association is either poorly advised in regard to roentgenological matters or they lack the proper understanding of properly educating the public. Certainly we cannot believe that a reputable roentgenologist of experience would use the fluoroscopic examination for the early diagnosis of pulmonary tuberculosis rather than the film method. We agree that in a number of instances wherein a chest examination is being made for suspected pulmonary tuberculosis, the fluoroscope can be of aid in visualizing adhesions of the diaphragm, aneurysms, etc. The x-ray films are universally used in the diagnosis of early pulmonary tuberculosis, and it is, then, for the N. T. A. to know and practise this.

We cannot understand how a large and important organized body would unhesitatingly recommend the use of the fluoroscope, with its attendant dangers and limitations in the diagnostic field of medicine, for the diagnosis of pulmonary tuberculosis. Such propaganda can and has done a great deal of harm, and those who are inclined to believe that the indiscriminate use of the fluoroscope is justifiable should be warned by someone with experience of its danger. They should be told that it does not furnish the desired diagnostic information in pulmonary tuberculosis; this can be obtained only by x-ray films.

It has not been long since we took exception to this same National Tuberculosis Association for its recommendation of the use of sensitive paper instead of films for the diagnosis of tuberculosis by the x-ray. It should be recalled that the Association, in 1931, recommended the use of the fluoroscope in the diagnosis of early tuberculosis, and, in 1934, sensitive paper. We wonder what will be the next change in 1935. We hesitate to make a prediction, as only a bold prophet will foretell its future action.

We consider that the abuse of the fluoroscope is of serious importance, especially when so

[1] We have just received the leaflet of the N. T. A. (September, 1934) in which the prediction is made that "The day will come when most physicians will have fluoroscopes in their offices, and will be *sufficiently trained* to use these, not only as an essential aid in the detection of *early tuberculosis*," etc. (The *italics* are mine.)

many high-powered salesmen of x-ray equipment are trying to sell fluoroscopes to be used for all kinds of x-ray diagnosis. No doubt many physicians, after reading this pronouncement by the National Tuberculosis Association have equipped themselves with a fluoroscope, and begun to make diagnoses of pulmonary tuberculosis.

We wish at this time to issue a warning to physicians who contemplate purchasing fluoroscopic apparatus from high-pressure salesmen that this is a lot of bally-hoo. Don't believe it—it can't be done.

Our attention has been called to this condition by members of the medical profession, and we unhesitatingly condemn the indiscriminate use of the fluoroscope. We urge all roentgenologists to institute a campaign of education in its use and abuse.

COMMUNICATIONS

AMERICAN RADIUM SOCIETY

RESOLUTION

The following resolution was presented by the Executive Committee and adopted unanimously by the American Radium Society, Cleveland Session, June 12, 1934.

WHEREAS, it has been proven that radium or x-rays, when used properly, and in sufficient quantity, is efficient in the treatment of cancer in certain locations, and

WHEREAS, there is a general fear in the public mind from x-ray or radium burns, which, because of this fear, prevents competent radiologists from using sufficient radium or x-ray to produce the best results;

BE IT RESOLVED that we as radiologists recognize that in the treatment of malignant disease, it is often necessary to carry the treatment on to the extent of producing a violent reaction in the surrounding tissues, which may cause the skin to peel, and blisters to form, in order to give sufficient treatment to overcome the malignant disease. We believe, therefore, that it is justifiable to produce a second degree radiodermatitis when necessary.

RESOLUTIONS ADOPTED BY AMERICAN RADIUM SOCIETY AT ANNUAL MEETING, CLEVELAND, JUNE 12, 1934; ALSO ADOPTED BY AMERICAN COLLEGE OF RADIOLOGY, JUNE 12, 1934

The Indiscriminate Use and Rental of Radium

WHEREAS it is now recognized that radium has been demonstrated to be of definite value in the treatment of disease, and

WHEREAS some States and many communities in the country have little or no radium available, and

WHEREAS funds are not always available for the purchase of suitable preparations of radium for use by those physicians who are qualified in radium therapy, and

WHEREAS we recognize that radium is an agent quite as potent for doing harm as for doing good when used without sufficient skill or training, and with the hope of protecting the uninformed public from serious and irreparable injury from improper and insufficient treatment;

BE IT RESOLVED that we consider it improper, unethical, and detrimental to the science of radiology and to the good of suffering humanity for commercial laboratories to attempt to give advice or directions as to the use of radium in the case of a patient whom the person giving that advice has not even had the opportunity to examine. In other words, it is just as difficult to give such advice and directions as it would be for a surgeon to give directions for the use of rented surgical instruments so that an untrained physician might attempt an operation. Various commercial companies advertise both in the journals and through the mails, medical advice for the purpose of making sales or renting radium or radon. This places those corporations in the field of practising medicine.

BE IT RESOLVED that the same criticism be applied to institutions which rent or furnish their radium to those members of their Staff or outside of the Staff who are unskilled in radium application.

RESOLVED that the same criticism applies to many individual owners of radium.

RESOLVED that we regard the approval of the National Board of Radiological Examiners as the minimum standard for those assuming the responsibility for using radium. We

recommend as wide publicity of this Board's existence and approval as is possible to the public, consistent with ethical practices, as the most effective safeguard which can be afforded them.

RESOLVED that we recommend the refusal of advertising matter in National and State Journals when the companies concerned are advertising a medical consulting service or are advertising such service through the mails in connection with their sale or rental of radium.

RESOLVED that we disapprove of any doctor's acting as a consultant to a commercial company carrying on such a campaign of public or private advertising and that we consider such an association sufficient grounds to warrant disbarment from the approval of the National Board of Radiological Examiners.

RESOLVED that we recognize the ethical commercial company as a necessity. It is the advertised consulting service that is at fault. It is recognized that such restrictions on the advertising of a medical service will in no way hamper properly qualified radium therapists in obtaining adequate supplies of radium or radon for the purposes for which they are qualified to use it.

RESOLVED that we approve an informal medical consultant for the guidance of those commercial companies who refrain from advertising such professional service, either publicly or privately, and that in such case their informal consultant be one approved by the National Board of Radiological Examiners.

ANNOUNCEMENTS

PRELIMINARY PROGRAM

ANNUAL MEETING

Let all those who have thoughts of attending our Memphis Annual Meeting, to be held at Memphis, Tennessee, December 3 to 7, inclusive, do so without fear of disappointment.

Your Committees have been working overtime to insure for you the utmost value for every moment you will spend there. No stone has been left unturned to secure whatever might be of assistance in making that occasion a memorable one.

It has been thought advantageous to incorporate several new features in the program which will enhance the value to the hundreds attending. Three distinct types of presentation will be offered, covering symposia on all the latest developments of our work. The General Sessions each morning will be in the form of lectures giving us the scientific contributions from our most outstanding men and covering the field of radiology to date.

The Scientific Exhibits will be featured every afternoon. We have arranged that each exhibitor will be given the opportunity before the General Assembly of amplifying the cardinal features of his exhibit.

Not the least important will be the daily Clinics, offering to us all the opportunity to obtain a concentrated post-graduate course through practical demonstration and questioning.

Let me also mention the Commercial Exhibits which will be shown. As a courtesy to our Commercial Exhibitors and for our own information we hope to arrange an opportunity for each manufacturer to have at least five minutes on the General Sessions program to announce his latest contributions to radiology.

In addition to all these, we are introducing the Carman Lecture, which will be instituted on what we are pleased to call "The Carman Night," December 4. This will be an important addition to our program.

Wednesday night, "Memphis Night," is going to be different—something which the members from the North, East, and West will long remember—a real event with a Southern setting.

We have endeavored to maintain the high standard of our Banquet Night. It will be replete with good things—not too much but just enough.

Do not neglect our ladies. The local hosts are preparing to receive them. Garden parties, teas, drives, and banquets will insure days full of happy associations.

We are going to Memphis, Tennessee, a setting in the historical South, renowned for its hospitality and graciousness. All has been done to insure for everyone a most profitable and enjoyable time. You cannot afford to miss it. Get in touch with J. Cash King, M.D., the Chairman of Hotels, Memphis, who will make the necessary reservations for you.

Hoping to see you there.

W. HERBERT MCGUFFIN, M D., *President*

Opening Ceremonies

Monday, December 3, 1934. W. S. Lawrence, M.D., Local Committee of Arrangements, *Chairman*

Addresses of Welcome

Honorable Watkins Overton, Mayor of Memphis

E. C. Ellett, M.D., Representative of Medical Profession of Memphis

Mr. George Morris, Editor-in-chief, *Memphis Commercial Appeal*

Acceptance of Memphis Hospitality

T. A. Burcham, M.D., *Chairman*, Executive Committee, Radiological Society of North America

Formal Opening of Convention

W. H. McGuffin, M.D., President, Radiological Society of North America

Formal Opening of Commercial Exhibits

C. H. Heacock, M.D., *Chairman*, Transportation and Commercial Exhibits Committee

SCIENTIFIC SESSION

Monday, December 3, 1934, 10:30–12:30 A.M.

Symposium on Urology

Arranged by B. H. Nichols, M.D., Cleveland, Ohio.

"Excretion Urography in Differential Diagnosis of Some Renal and Perirenal Lesions." Robert A. Arens, M.D., Roentgenologist, and A. E. Jones, M.D., Urologist, Michael Reese Hospital, Chicago.

"Multiple Urograms in Urinary Diagnosis." E. C. Baker, M.D., Roentgenologist, and J. S. Lewis, M.D., Urologist, Youngstown City Hospital, Youngstown, Ohio.

"Urological Problems in Childhood." W. J. Engel, M.D., Urologist, Urological Section, Cleveland Clinic, Cleveland, Ohio.

"Roentgen Therapy in Wilm's Tumor (Embryonic Carcinoma) of the Kidney, with an Analysis of Six Cases." E. A. Pohle, M.D., Ph.D., Dept. of Radiology and Physiotherapy, University of Wisconsin, Madison, Wis.

Discussant: R. S. Hennessey, M.D., Urologist, Memphis, Tenn.

Monday, December 3, 1934, 2:00–3:30 P.M.

Symposium on Gastro-intestinal Tract

Arranged by B. R. Kirklin, M.D., Rochester, Minn.

"Increased Irritability of the Gastro-intestinal Tract: A Discussion of Disturbed Physiology." Barton A. Rhinehart, M.D., Associate Professor, Roentgenology, Arkansas University School of Medicine, Little Rock.

"Importance of Roentgen Gastric Functional Study in the Differential Diagnosis of Pyloric Lesions." W. H. Meyer, M.D., Director, Department of Roentgenology, New York Post-graduate Medical School and Hospital of Columbia University, New York City.

"The Study of the Esophagus in Relationship to the Heart and Great Vessels." Samuel Brown, M.D., Assistant Professor of Roentgenology, University of Cincinnati, Cincinnati, O., and Justin E. McCarthy, M.D., Radiologist, Good Samaritan Hospital, Cincinnati, O.

Monday, December 3, 1934, 7:00 P.M

Counselors' Dinner

Executive Session
Counselors' Reports
Committees' Reports
President's Address

Tuesday, December 4, 1934, 8:30–10:30 A.M.

Symposium on Silicosis

Arranged by E. C. Ernst, M.D., St. Louis, Mo. Roentgenologic Aspect.

Etiological Aspect. R. R. Sayers, M.D., Medical Officer-in-Charge of Industrial Hygiene and Sanitation of the Public Health Service, Washington, D. C. (*by invitation*).

Pathological Aspect. Leroy U. Gardner, M.D., Director of the Saranac Laboratory for the Study of Tuberculosis of The Edward L. Trudeau Foundation, Saranac Lake, N. Y., (*by invitation*).

Clinical Aspect. Anthony J. Lanza, M.D., Assistant Medical Director of the Metropolitan Life Insurance Company, New York City (*by invitation*).

Tuesday, December 4, 1934, 10:30–12:30 A.M.

Symposium on Thoracic Neoplasms

Arranged by J. T. Farrell, Jr., M.D., Philadelphia.

"Congenital Cysts of the Lungs." James L. Dubrow, M.D., Des Moines, Iowa.

"Primary Carcinoma of the Lungs." Charles H. Heacock, M.D., and J. Cash King, M.D., Memphis.

"Extra-pulmonary Thoracic Tumors." Carleton B. Peirce, M.D., Ann Arbor, Mich.

"Mediastinal Tumors." William A. Evans, M.D., and E. R. Witwer, M.D., Detroit.

"Pulmonary Metastases." J. T. Farrell, Jr., M.D., Assistant Roentgenologist, Jefferson Hospital, Philadelphia.

Tuesday, December 4, 1934, 2:00–3:00 P.M.

Executive Session

3:00–3:30 P.M.

"Unification of Radiological Societies." Rollin H. Stevens, M.D., President of American Radium Society, 1933-34, Detroit, Mich.

Tuesday, December 4, 1934, 8:30 P.M.

Carman Night

Introduction, President W. H. McGuffin, M.D.

The Carman Lecture

"Some Phases of Radiologic Diagnosis of Gastric Cancer." B. R. Kirklin, M.D., Head of Section of Roentgenology, Mayo Clinic, Rochester, Minn.

An Appreciation:

"The Debt of Surgery to Roentgenology." D. C. Balfour, M.D., Surgical Section, Mayo Clinic, Rochester, Minn.

Closing, W. L. Williamson, M.D., President of Memphis and Shelby County Medical Society.

Wednesday, December 5, 1934, 8:30–10:30 A.M.

Symposium on Chronic Arthritis

Arranged by H. P. Doub, M.D., Detroit.

"Medical Aspects of Chronic Arthritis." Ralph A. Kinsella, M.D., Professor of Medicine, St. Louis University, St. Louis.

"Surgery as an Adjunct to the Treatment of Arthritis." Willis C. Campbell, M.D., Professor of Orthopedic Surgery, University of Tennessee, Memphis, Tenn.

"Roentgen Diagnosis of Chronic Arthritis." Howard P. Doub, M.D., Roentgenologist, Henry Ford Hospital, Detroit, Mich.

"Physical Therapy, Fever Therapy and Radiotherapy of Chronic Arthritis." Arthur U. Desjardins, M.D., Head of Section on Therapeutic Radiology, Mayo Clinic, Rochester, Minn.

Discussants: Robert S. Stone, M.D., University of California, Oakland, Calif.

John D. Camp, M.D., Mayo Clinic, Rochester, Minn.

Wednesday, December 5, 1934,
10:30–12:30 A.M.

Symposium on Physics of Radiation

Arranged by Dr. Lauriston Taylor, Washington, D. C.

"Intensity and Dosage near Radium Needles." Dr. C. G. Laurence, Canadian National Research Council, Ottawa, Canada.

"The Correlation of X-radiations Produced with Different Voltages and Filtrations." Lauriston S. Taylor, Chief, X-ray Laboratories, National Bureau of Standards, Washington, D. C.

"Further Studies in the Relation between the Roentgen and Radium Dose in Milligram Element Hours at 1 cm. Distance." Otto Glasser, Ph.D., Director, Department of Radiation Research, Cleveland Clinic Foundation, Cleveland, O.

"Quality Measure and Distance Doses of White X-ray Beams." A. Mutscheller, Ph.D., Director of Research, Westinghouse X-ray Company, Inc., New York City.

"A Distribution of Roentgen Radiation in the Pelvis in the Treatment of Carcinoma of the Cervix." A. N. Arneson, M.D., and Edith H. Quimby, M.A., Memorial Hospital, New York City.

Wednesday, December 5, 1934, 2:00–3:30 P.M.

Symposium on Ductless Glands

"X-ray Treatment of Hypo-glycemia." S. C. Barrow, M.D., Radiologist, Schumpert Sanatorium, Shreveport, La.

"Radiotherapeutic Treatment of Hypertension and Diabetes." James H. Hutton, M.D., Chicago.

Discussant: Maximilian J. Hubeny, M.D., Chicago.

Thursday, December 6, 1934, 8:30–10:30 A.M.

Symposium on Mouth and Neck

Arranged by Albert Soiland, M.D., Los Angeles, Calif.

"Intra-oral Cancer and its Treatment." Orville N. Meland, M.D., Soiland Clinic, Los Angeles, Calif.

"The Treatment of Laryngeal Carcinoma by the X-ray: Report of Cases." I. Seth Hirsch, M.D., Professor of Roentgenology, New York University and Bellevue Medical School, New York City, and Samuel M. Baum, M.D., Radiation Therapist, Beth Israel Hospital, New York City.

"Treatment of Malignancies of Larynx and Hypopharynx." L. H. Garland, M.D., San Francisco.

"The Treatment of Cancer of the Cheek." G. E. Pfahler, M.D., Professor of Radiology, Graduate School of Medicine, Philadelphia.

Thursday, December 6, 1934, 10:30–12:30 A.M.

Symposium on Breast and Pelvis

Arranged by Albert Soiland, M.D., Los Angeles, Calif.

"Application of Endocrine Studies to Radiation Therapy, with Special Reference to Breast and Pelvic Pathology." Milton Friedman, M.D., and Rita Finkler, M.D., Newark, N. J.

"Pre-operative and Pre-radium Irradiation of Carcinoma of the Breast, Cervix, and Urinary Bladder." J. Thompson Stevens, M.D., Director Depts. for Study and Treatment of Neoplastic Diseases, Montclair Community Hospital, Montclair, N. J.

"Breast Cancer: Its Detection and Treatment." B. H. Orndoff, M.D., Professor Radiology, Loyola University School of Medicine, Chicago.

"Radiotherapeutic Aspects of Adenomyoma of Recto-vaginal Septum." H. H. Bowing, M.D., Head of Section on Radium Therapy, Mayo Clinic, Rochester, Minn.

Thursday, December 6, 1934, 2:00–3:00 P.M.

EXECUTIVE SESSION

3:00–3:30 P.M.

"Economics"

Thursday, December 6, 1934, 8:30 P.M.

Banquet

Music

Announcements, W. S. Lawrence, M.D., Local Committee of Arrangements

Chairman's Address, President W. H. McGuffin, M.D.

Awards

Guest Speaker, Honorable Harvey T. Harrison, Little Rock, Arkansas. "The Funny Bones of the Human Head, by the Light of the Co(s)mic Ray"

Induction of new officers and presentation of gavel to new President, Lloyd Bryan, M.D.

Friday, December 7, 1934, 8:30–10:30 A.M.

Symposium on Dermatology

Arranged by Rollin H. Stevens, M.D., Detroit, Mich.

Friday, December 7, 1934, 10:30–12:30 A.M.

Symposium on Bone Tumors

Arranged by R. T. Wilson, M.D., Temple, Texas.

"Osteogenic Sarcoma: Roentgenologic Characteristics." R. T. Wilson, M.D., Scott and White Clinic, Temple, Texas.

"Bone Lesions in Children." J. I. Mitchell, M.D., Memphis.

"Osteogenic Sarcoma: Pathologic Characteristics." Charles Phillips, M.D., Temple, Texas.

Discussants: Max Kahn, M.D., Baltimore. Willis Campbell, M.D., Memphis.

Friday, December 7, 1934, 2:00–3:30 P.M.

Symposium on Spinal Lesions

Arranged by W. W. Wasson, M.D., Denver.

"Radiological Study of Vertebral Column." Bernard R. Mooney, M.D., Radiologist to Edmonton General Hospital and Misericordea Hospital, Edmonton, Alberta, Canada, and P. H. Malcolmson, M.D., Radiologist, Edmonton, Alberta, Canada.

"The Early Stages of Spondylitis Ankylopoietica." Jacques Forestier, M.D., Aix-les-Bains, France.

CLINICS

Diagnostic and therapeutic clinics have been arranged for the meeting. Each clinic will be held on two afternoons and each clinician will demonstrate, by means of apparatus and appliances, the method of carrying out the diagnostic and therapeutic procedures of his subject. Lantern slides will supplement these demonstrations so that they will be diagnostic as well as technical. The following have agreed to present clinics. Undoubtedly others will be added to the program.

"Esophagus." J. T. Farrell, Jr., M.D., Assoc. in Roentgenology, Jefferson Medical College, Philadelphia.

"Stomach and Duodenum." B. R. Kirklin, M.D., Head of Section of Roentgenology, Mayo Clinic, Rochester, Minn.

"Ventriculography." W. E. Chamberlain, M.D., Prof. Radiology, Temple University Medical School, Philadelphia.

"Intravenous Urography." B. H. Nichols, M.D., Roentgenologist, Cleveland Clinic, Cleveland, O.

"Spinal Cord Tumors." John D. Camp, M.D., Associate in Section on Roentgenology, Mayo Clinic, Rochester, Minn.

"Pelvimetry." R. P. Ball, M.D., Director of Laboratories, The Baroness Erlanger Hospital, Chattanooga, Tenn., and S. S. Marchbanks, M.D., Dermatologist, The Baroness Erlanger Hospital, Chattanooga, Tenn.

"Leukemia." E. A. Pohle, M.D., Ph.D., Dept. of Radiology, University of Wisconsin, Madison, Wis.

"Cholecystographic Diagnosis." David S. Beilin, M.D., Radiologist, Augustana Hospital, Chicago.

"Detailed Procedure in Determining Proper Roentgen Dosage for Any Given Case." A. W. Erskine, M.D., Radiologist, Cedar Rapids, Iowa.

"Therapeutic Injections of Lipiodol as a Relief for Pains of Loco-motor System and Their Roentgenological Control." J. Forestier, M.D., Aix-les-Bains, France.

"Malignancy of the Lower Lip." W. H. McGuffin, M.D., Director, Radium and X-ray Institute, Calgary, Alberta, Canada.

"Radiography of the Diaphragm and its Abnormalities." Kenneth D. A. Allen, M.D., Denver, Colorado.

"Treatment of Uterine Malignancy." Norman Arneson, M.D., New York City.

"Roentgenology of the Spine." Howard P. Doub, M.D., Detroit, Michigan.

"Examination of the Accessory Sinuses with Opaque Oils." Edwin C. Ernst, M.D., St. Louis.

"Retrograde Pyelography." Theodore R. Fetter, M.D., Philadelphia.

"Roentgenography of the Sphenoid Sinus." Amédée Granger, M.D., New Orleans, La.

"Roentgen Therapy of the Spinal Nerves for Pain." Byron H. Jackson, M.D., Scranton, Pa.

"Roentgen Examination of the Breast." Ira H. Lockwood, M.D., Kansas City, Mo.

"Roentgen-ray Treatment with 800 K.V. Pulsating Current." Henry Schmitz, M.D., Chicago.

"Radiation Therapy of Carcinoma of the Breast." Max Cutler, M.D., Chicago.

"Roentgen Examination of the Colon," H. E. Illick, M.D., New York City.

SCIENTIFIC EXHIBITS

"New Safety Control Devices for Filters in X-ray Therapy." Gentz Perry, M.D., Radiologist, Evanston, Illinois.

"Acute Silicosis Cases in Pulverizing Plants of New Jersey: A Radiologic, Microscopic, and Experimental Survey." Raphael Pomeranz, M.D., Associate Roentgenologist, Newark Beth Israel Hospital, Newark, N. J.

"Roentgen Radiation in Carcinoma of Cervix Uteri—Distribution of Radiation within Female Pelvis for Different Port Arrangements and Target-skin Distances." A. N. Arneson, M.D., and Edith H. Quimby, M.A., Associate Physicist, Memorial Hospital, New York City.

"Differential Diagnosis of Pulmonic and Gastric Lesions." I. S. Trostler, M.D., Radiologist, Chicago.

"Roentgen Kymography—The Graphic Representation of Visceral Movements." I. Seth Hirsch, M.D., Professor of Roentgenology, New York University and Bellevue Medical School, New York City.

"The Position of Esophagus under Abnormal Conditions of Heart and Great Vessels." Samuel Brown, M.D., Assistant Prof. Roentgenology, University of Cincinnati, Cincinnati, O., and Justin E. McCarthy, M.D., Radiologist, Good Samaritan Hospital, Cincinnati, O.

"Important Factors in Technic of Soft Tissue Radiography." John R. Carty, M.D., Radiologist, New York Hospital, New York City.

"Observations on Functioning of Radiofrequency High Voltage X-ray Apparatus, with Some of its Physical Characteristics." Robert S. Stone, M.D., Ass't. Prof. Roentgenology, Univ. of California Medical School, San Francisco, Calif.

"Benign Tumors of the Stomach (with Particular Reference to Their Incidence and Malignant Degeneration)." Leo G. Rigler, M.D., Professor of Radiology, University of Minnesota, Minneapolis, Minn., and Lester G. Ericksen, M.D., Roentgenologist, Finley and Mercy Hospitals, Dubuque, Iowa.

"The Effect of Thorium Dioxide Sol on the Human Liver and Spleen." Leo G. Rigler, M.D., Professor of Radiology, University of Minnesota, Minneapolis, Minn., and Rudolph Koucky, M.D., and A. L. Abraham, M.D., Minneapolis, Minn.

"Biliary Colic with Fistula." H. B. Podlasky, M.D., Associate Clinical Professor and Director, Dept. of Roentgenology, Marquette University, Milwaukee, Wis.

"Neurotrophic Lesions of Lower Extremities Caused by Myelodysplasia in the Spinal Cord." Lester A. Smith, M.D., Asst. Professor of Radiology, University of Indiana Medical School, Indianapolis, Indiana.

"Cases of Xanthomatosis Involving Bone." Lester A. Smith, M.D., Asst. Professor of Radiology, University of Indiana Medical School, Indianapolis, Indiana.

View of Memphis, Tenn.

NEXT ANNUAL MEETING

Memphis, Monday, Dec. 3—Friday, Dec. 7

Memphis, outstanding center in southern cotton and hardwood production (population, 261,000), dates its beginning from May, 1541, when the great De Soto first discovered the Mississippi River from the Chickasaw Bluffs on which Memphis is built.

The site of the future city remained, however, only an Indian village and an occasional temporary Spanish or French fortification for more than two centuries—until after the American Revolution, in fact. The city itself was established in 1819 when Andrew Jackson, later to become President of the United States, James Winchester, and John Overton came from Nashville to lay out the streets of the town on land which they had recently acquired. Incorporated in the same year, the young city grew as a cotton market and as a center of distribution by virtue of its position on the Mississippi River, in the days when side-wheel steamboats were in the heyday of their usefulness. A yellow fever epidemic in the late seventies, following the Civil War and reconstruction troubles, created a pause in the city's progress. However, recovery after 1890 was rapid, as the city began its transition from a market place for a vast agricultural area to its present position as a manufacturing and distribution center.

Memphis in 1930 still remained the world's largest inland cotton market, handling annually approximately 2,000,000 bales through the Memphis Cotton Exchange. It likewise continued in its position of world's largest hardwood lumber market and an outstanding center of the woodworking industry, including not only lumber but hardwood flooring, furniture, wooden parts for automobile bodies, automobile wheels, golf shafts and blocks, shuttle blocks, tool handles and a wide variety of allied products.

Transportation facilities which have been influential in Memphis' growth include nine railroad systems with seventeen separate radiating lines converging at Memphis; four barge lines connecting Memphis with New Orleans, St. Louis, Cincinnati, Pittsburgh, Minneapolis, and St. Paul; airline connection with New Orleans and St. Louis; nine major highway routes, which converge in Memphis to cross the Mississippi on the Harahan bridge. Five major bus line systems likewise aid transportation in Memphis.

Memphis' business district is concentrated in an area close to the Mississippi River.

A landscaped parkway skirts the northern, eastern, and southern sides of the central portion of the city, connecting at its western end with the partially completed Riverside Boulevard which will overlook the Mississippi from an embankment under construction approximately half-way between the top of the Bluffs and the waterline. On the Parkway are located Riverside Park, a scenic area of more than six hundred acres overlooking the river; Overton Park, which includes one of the city's three public golf courses, the Overton Park Zoo, one of the five largest zoological gardens in America, and the Brooks Memorial Art Gallery. Supplied by artesian wells, Memphis has the largest water system of its kind in the world.

It is likewise a center of medical sciences with hospitals which serve a large area outside of the city proper.

For the convenience of our readers who are planning to attend the Annual Meeting of the Radiological Society of North America at Memphis, Tennessee, from Monday, Dec. 3 to Friday, Dec. 7, 1934, we have ascertained the names of the hotels in Memphis, together with their rates, which we present herewith.

The meeting is to be held in the Hotel Peabody, and for that reason we show several views from which one may judge of the accommodations available.

The indications seem to point to the largest attendance in a number of years, so it is suggested that hotel reservations be made early.

MEMPHIS HOTEL RATES

Hotel Peabody (625 rooms—all with bath).

Single	Double	Twin-bedded
$3.00	$4.00	$6.00
3.50	5.00	7.00
4.00	5.50	8.00
5.00	6.00	

$1.50 each for extra beds in room.
Studio Suites, $8.50 to $20.00 per day.

Hotel Gayoso (300 rooms—120 without bath).

WITHOUT BATH

Single	Double and Twin	For Three
$1.50	$2.50	$3.50
2.00	3.00	4.00

Hotel Peabody, Memphis, Tenn.
View of Studio Suite.

WITH BATH

Single	Double and Twin	For Three
$2.00 to $4.00	$3.50 to $6.00	$4.50 to $7.50

Hotel Chisca (400 rooms—50 without bath).

WITHOUT BATH

Single	Double	Twin-bedded
$1.50	$2.00	
2.00	2.50	

WITH BATH

Single	Double	Twin-bedded
$2.00	$3.00	$4.00
2.50	3.50	4.50
3.00	4.00	5.00
5.00	6.50	

Hotel Parkview (200 rooms—all with bath).

Single	Rate for Two
$2.50	$3.00
3.00	4.00

William Len Hotel (250 rooms—all with bath).

Single	Double	Twin-bedded
$2.00	$3.00	$4.50
2.50	3.50	5.00
3.00	4.00	

Studio Suites, $6.00.
For Two, Three, or Four, $7.50.

Devoy Hotel (150 rooms—all with bath).

Single	Double and Twin
$1.75 to $4.00	$2.50 to $6.00

The Committee on Entertainment of Visiting Women submits the following tentative program:

MONDAY

Afternoon—Registration.

Evening—Reception, Hotel Peabody, Louis XVI Room; Music, Refreshments.

TUESDAY

Afternoon—Automobile tour to Arkansas and Mississippi, visiting cotton plantations.

Golf, Memphis Country Club and Colonial Country Club.

Dining Room, Hotel Peabody, Memphis.

Hotel Ambassador (140 rooms).

Single	Double	Twin-bedded
$1.00	$2.00	$4.00
1.50	2.50	

Hotel Claridge (400 rooms—all with bath).

Single	Double	Twin-bedded
$2.50	$3.50	$4.00
3.00	4.00	4.50
	4.50	5.00
	5.00	

Hotel Adlerr (200 rooms).

Rates, $1.50 to $2.50 with bath.

Hotel Tennessee (200 rooms).

Single	Double and Twin
$1.75 to $4.00	$2.50 to $6.00

Horseback riding, starting from Fair Gounds.

Evening—Theater party.

WEDNESDAY

Afternoon—Shopping tour, golf, horseback riding.

Evening—Banquet, Hotel Peabody.

THURSDAY

Afternoon—Automobile tour of Memphis, with visit to Brooks Memorial Art Gallery and Pink Palace Museum.

Golf, horseback riding.

Evening—Nineteenth Century Club—bridge and swimming.

There will likely be several functions to add to the above.

CONLEY H. SANFORD, M.D., *Chairman*

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Hans W. Hefke, M.D., of Milwaukee, Wis.
Hans A. Jarre, M.D., of Detroit, Mich.
Ernst A. Pohle, M.D., Ph.D., of Madison, Wis.
Charles G. Sutherland, M.D., of Rochester, Minn.

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Abstracts of Current Literature

ACTINOMYCOSIS

The Roentgen Therapy of Actinomycosis. R. Stewart-Harrison. Röntgenpraxis, March, 1934, **6,** 180–184.

Quoting the results of roentgen therapy in actinomycosis, the author describes the technic of irradiation used in Zürich. He recommends the protracted fractionated method because of its better cosmetic results. A daily dose of 240 r is given for from five to eight times. The factors are: 60 cm. distance; a filter of 1.3 mm. copper; 170 K.V., and about 2.5 to 3.5 r per minute. All cases with actinomycosis of the glands of the neck could be cured. The author hopes that the protracted fractionated method of roentgen therapy may prove to be superior to other technics in the more difficult treatment of deeply situated actinomycosis.

HANS W. HEFKE, M.D.

Generalized Actinomycosis. Hans R. Schinz and R. Blangey. Röntgenpraxis, March, 1934, **6,** 169–172.

A generalized hematogenous actinomycosis is very rarely seen, only about a dozen cases having been described. In a 13-year-old boy an infiltrative process was found roentgenologically in the right upper lobe. An atypical tuberculosis was thought of until actinomycosis was diagnosed from a biopsy of a tumor of the skin. Two months later the infiltration in the right upper lobe had progressed; there was also a miliary infiltration in the left lung which could not be differentiated from a miliary tuberculosis. At autopsy a chronic indurative actinomycosis was found in the right upper lobe, which had perforated into the superior vena cava and had led to a miliary dissemination of the actinomycosis in the lungs, kidneys, bones, muscles, and skin.

HANS W. HEFKE, M.D.

APPARATUS

Investigations on Light Dosimetry. I.—The Photoelectric Cell. W. Friedrich and R. Schulze. Strahlentherapie, 1934, **50,** 369–398.

The authors undertook a systematic analysis of the photo-electric cells available for measuring light, and found a lack of uniformity in response and of reproductivity. After a thorough experimental study they succeeded in constructing cells which answered all necessary requirements. The method of construction is given in detail in the paper.

ERNST A. POHLE, M.D., Ph.D.

Fundamental Considerations in the Use of the Body Cavity Tube. W. Schaefer and E. Witte. Strahlentherapie, 1934, **50,** 579–596.

In previous communications the authors have described the construction and use of an x-ray tube which may be inserted into the body cavities. This technic permits the application of high doses to the tumor and, at the same time, protection of the surrounding tissues. Further details as to the proper treatment technic are given in this article, with charts showing the distribution of radiant energy in the body. A few illustrative case reports of patients with genital carcinoma are appended.

ERNST A. POHLE, M.D., Ph.D.

"Shadowless" Sphere Ionization Chambers. E. Miehlnickel and B. Rajewsky. Strahlentherapie, 1934, **50,** 499–515.

The authors developed a small ionization chamber of spheric shape which is attached to an amber rod and absorbs, therefore, very little radiation. When submerged in water and radiographed it is practically "shadowless." The construction of the chamber and the process of manufacturing are described in detail, as well as numerous tests that show that with proper dimensions of the inner electrode the r unit can be measured directly with this new chamber.

ERNST A. POHLE, M.D., Ph.D.

THE APPENDIX

Post-appendicitic Abscess Demonstrated on Roentgenograms. F. W. Schembra. Röntgenpraxis, March, 1934, **6,** 167–169.

Perityphilitic abscesses after appendicitis may usually be demonstrated easily on roentgenograms. They cause a round, sharply defined filling defect in the cecum without any changes in the mucosa and are always seen in the median aspect of the cecum. Another group of abscesses is in direct communication with the cecum (by perforation). The contrast material is then seen to leave the cecum and is found either in the pelvis or even in the muscles of the thigh or as a paranephritic abscess. In such instances the differential diagnosis from tuberculosis, carcinoma, and actinomycosis has to be made.

A case is described in which the barium mixture left the cecum on its lateral aspect and filled a large irregular cavity which extended into the muscles of the thigh. Operation and autopsy confirmed the diagnosis of post-appendicitic abscess.

HANS W. HEFKE, M.D

The Appendix Morphologically Considered. Richard A. Rendich and Bernard Ehrenpreis. Am. Jour. Roentgenol. and Rad. Ther., December, 1933, **30,** 791–796.

Out of an unselected series of 141 routine gastrointestinal studies, the appendix was visualized in 72 per cent. By further study, that is, after the barium clysma after evacuation of, or 6 or 24 hours after the

clysma, or after sediment mixture ingestion following catharsis, this percentage was increased to 90 per cent. Non-visualization may be on a purely physiological basis (appendix having filled and emptied between observations), or due to obstruction of the lumen caused by the following conditions: normal appendiceal feces; spasm at the ostium or possibly of the shaft; pathologic obliteration of the lumen. The important signs of pathology are: unquestionable tenderness on palpation over the visualized appendix, reflex phenomena of spasm elsewhere along the alimentary tract, and undoubted fixation of shaft or tip. The authors made careful studies of both the normal and pathologic appendix by radiographing the part after having injected it with barium following its surgical removal, and also, by the study of similarly prepared appendices in Ringer's solution under the influence of 1–1000 pilocarpine solution. They conclude that there is often a recognizable difference of the barium shadow in normal and pathologic cases which seems characteristic of the underlying pathologic state of the appendiceal wall.

J. E. HABBE, M.D.

BONE DISEASES (THERAPY)

Osteitis Deformans (Paget) and Diabetes Insipidus. O. Rummert. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1934, **49**, 85–90.

A case of osteitis deformans complicated by diabetes insipidus is reported, which responded well to hypophyseal medication. An etiologic relationship between Paget's disease and hypophyseal dysfunction is assumed. It is also stated that sp aving of preparations of hypophysis to the nasal membranes is the most satisfactory mode of administration over long periods.

H. A. JARRE, M.D.

BREAST

Calcareous Deposits in the Lactiferous Tubules of Both Breasts. R. Finsterbusch and F. Gross. Röntgenpraxis, March, 1934, **6**, 172–174.

All breast tumors are examined roentgenologically at the Surgical Clinic of the University of Leipzig. In a woman with a carcinoma of the breast a heretofore not described calcification of the lactiferous tubules was seen. The roentgenogram of both breasts showed multiple round or oval and elongated shadows of the density of calcium. From their distribution and arrangement, calcification of the ducts was diagnosed roentgenologically and confirmed after amputation of one breast. The patient had never had a mastitis. The authors believe that the calcifications took place because none of the nine children had been nursed by the mother and that stagnation of the secretion, so often repeated, caused the deposit of lime salts.

HANS W. HEFKE, M.D.

CANCER (THERAPY)

Treatment Methods at the Women's Clinic in Erlangen for Roentgen Therapy of Carcinoma of the Female Genital Organs. Franz Wittenbeck. Strahlentherapie, 1934, **50**, 399–427.

The technic employed at the Women's Clinic at the University of Erlangen as developed by Wintz in the treatment of carcinoma is described by the author. Before administering roentgen therapy copper iontophoresis is used; this serves not only as a disinfectant but also increases the secondary radiation and is supposed to have a direct effect on carcinoma cells. In conclusion, the author states that an improvement of the results can be obtained only by treating carcinoma in its early stages.

ERNST A. POHLE, M.D., Ph.D.

The Seminoma (Embryonic Carcinoma) of the Testicle and the Ovary. Antoine Béclère. Strahlentherapie, 1934, **50**, 597–610.

The pathologic aspect of embryonic carcinoma of the testicle and ovary is discussed briefly, followed by a review of the literature concerning radiation therapy in these highly radiosensitive tumors. The latest investigations of Ferguson (Memorial Hospital) are quoted freely. The author's indications for irradiation are, in general, in agreement with those recognized in this country.

ERNST A. POHLE, M.D., Ph.D.

Lymphoepithelial Tumors (Transitional Cell Carcinoma). Emil Maier. Strahlentherapie, 1934, **50**, 611.

Following a discussion of the pathologic and clinical aspects of lymphoepithelioma (transitional cell carcinoma), the author emphasizes the radiosensitivity of these tumors. If properly treated according to the Coutard method the percentage of three-year cures varies from 45 to 55 per cent.

ERNST A. POHLE, M.D., Ph.D.

Further Contribution to the Roentgen Therapy of Carcinoma at Short Focal Skin Distance. H. Chaoul. Strahlentherapie, 1934, **50**, 446–452.

The author gives further data concerning the method of irradiation at short focal skin distance (60 K.V., 0.2 mm. Cu, 5 cm. F.S.D.). The preliminary results are encouraging; 90 per cent of 103 tumor cases of various types are free from symptoms for one to three years. He relates the history of a man with a carcinoma of the rectum the size of an apple. A colostomy was done and the coccyx and sacrum resected to render the tumor accessible for direct irradiation. Within a period of four weeks 9,200 r were given; six weeks later the rectum was completely removed and histologic study did not show a trace of carcinoma.

ERNST A. POHLE, M.D., Ph.D.

CHEST, COLLAPSE THERAPY

Clinical Types of Therapeutic Pneumothorax and Their Significance. J. W. Cutler. Jour. Am. Med. Assn., July 14, 1934, **103**, 81–83.

Artificial pneumothorax is practised to-day in ap-

proximately 50 per cent of all cases and is the most remarkable advance made thus far in the treatment of pulmonary tuberculosis. It has undoubtedly considerably improved the prognosis of certain very common forms of this disease that formerly were regarded as invariably hopeless. Total collapse was first practised in 1884; as time went on clinical experience forced the conclusion that absolute immobilization of the entire lung was not essential to healing. Partial collapse, or hypotensive pneumothorax, that accompanied by low manometric readings or negative pressure, took root and operators soon applied this newer conception in their practice. With inevitable refinements and developments in technic, this became the selective collapse of to-day. The primary object of selective collapse is to maintain uniformly and continuously complete collapse of the diseased part of the treated lung and at the same time to permit full function of the healthy part.

The mechanics are discussed in detail. Selective collapse has greatly widened the indications for pneumothorax therapy and has made it possible for patients with extensive bilateral disease to participate in its benefits. It has reduced the incidence and seriousness of pleural effusions and is undoubtedly the procedure of choice. Simultaneous bilateral pneumothorax is applicable only in a limited number of cases, and when applied judiciously the results are satisfactory. In selected cases there need be no dyspnea or other signs of discomfort. In some instances the patients can be self-supporting while under treatment and within reasonable limits lead normal active lives. One should consider carefully the advantages of alternating successive pneumothorax and of pneumothorax on one side and phrenic evulsion combined with scaleniotomy on the other. Alternating, or successive pneumothorax, is the successive collapse of first one lung and then the other by artificial pneumothorax. This is especially indicated in patients who develop contralateral disease during pneumothorax treatment or who have bilateral disease equally distributed when first seen.

CHARLES G. SUTHERLAND, M.D.

CONTRAST MEDIA

Lipiodol in Bronchography: Its Disadvantages, Dangers, and Uses. J. Burns Amberson, Jr., and H. McLeod Riggins. Am. Jour. Roentgenol. and Rad. Ther., December, 1933, **30**, 727–746.

While the use of lipiodol for bronchography often makes possible the obtaining of important diagnostic information which can be gained by no other means, its indiscriminate use in poorly selected cases may be attended by very serious and even fatal after-effects. In any case with acute or subacute inflammation of the lungs or bronchi, with or without fever, the procedure should be postponed until the inflammation has subsided. It is unsafe to use lipiodol in the patient with a weak myocardium because of the dyspnea and pulmonary edema which may follow the instillation of the oil. Where there is extensive emphysema and pulmonary fibrosis, the procedure should be done with the greatest of caution because of the danger of cardiac failure. Bronchography should be dispensed with as much as possible in the chronic asthmatic. In all cases in which there is much expectoration, the bronchi should be drained posturally as completely as possible, a thorough cleansing of the mouth and throat tissues be performed before the oil is instilled, and routinely the oil should be promptly drained by postural method, rather than by coughing, after the necessary film and fluoroscopic studies have been made. In the authors' service at Bellevue Hospital, the procedure is performed in less than 1 per cent of the tuberculous patients and in approximately from 10 to 15 per cent of the non-tuberculous ones. The injection is ordinarily done by the supraglottic route, using a syringe and laryngeal cannula after previously giving codeine sulphate, from 0.5 to 1 gram, and sodium amytal, 3 grams by mouth, and applying 4 per cent aqueous cocaine hydrochloride to the pharynx and pillars. It is very preferable to use the lipiodol at a temperature of from 67 to 75° F. rather than to warm it, because when the oil flows too freely it tends to enter the terminal air sac in too large quantities, thereby being retained undesirably long in areas in which its beneficial effects are very doubtful. A number of cases are reported showing the bad results which may follow this diagnostic procedure, these being, on the one hand, in the nature of dissemination or aggravation of infectious processes already present in the chest, and, on the other hand, of sudden upset of respiratory or cardio-respiratory function.

J. E. HABBE, M.D.

CYSTICERCOSIS

Extensive Calcified Cysticercosis in the Human Body. Kurt Kremser. Röntgenpraxis, May, 1934, **6**, 300–304.

Calcified cysticerci have a typical roentgenologic appearance. They have a length of up to one centimeter, are oval or spindle-shaped, and their axis is parallel to the course of the muscle fibers. Quite often they have been accidentally discovered during a roentgen examination. The shadows of a calcified trichinosis are much smaller. In the case reported by the author the general symptoms of loss of weight, malaise, rheumatic pains, etc., pointed to a toxic action caused by the generalized infestation which could be demonstrated roentgenologically.

HANS W. HEFKE, M.D.

DENTAL RADIOGRAPHY

Roentgen Therapy of Paradentitis. K. Staunig. Strahlentherapie, 1934, **50**, 677–682.

In this paper the author relates in detail the technic of irradiation as developed by him in the treatment of paradentitis (see also *Strahlentherapie*, 1934, **50**, 453). As a rule, three fields are used and the angles of incidence of the central ray correspond to those customary in radiography of the teeth. A filter of 0.3 mm. Zn + 2.0 Al is inserted and doses of from 4 to 5 H are given

(λ_0 = 0.1Å.). The entire treatment is administered within from ten to fourteen days, using intervals of from five to seven days between fields.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy of Paradentitis. Kurt Neugebauer and Konrad Staunig. Strahlentherapie, 1934, **50**, 453–461.

Roentgen therapy proved to be of benefit in cases of paradentitis. While the symptoms appeared to be more severe during the first days after irradiation, definite improvement was noticeable in the majority of cases within a week. Most striking was the improvement in patients with loose teeth. Progress studies should be made both clinically and roentgenographically.

ERNST A. POHLE, M.D., Ph.D.

DOSAGE

The Dosis of Roentgen Rays. Hermann Behnken. Strahlentherapie, 1934, **50**, 476–483.

The Definition of the Absolute Unit of the Roentgen-ray Dose. L. Grebe. Strahlentherapie, 1934, **50**, 484–486.

Both authors offer a theoretical discussion in favor of a change in the definition of the r. Behnken's new definition would mean that a dose of 1 r corresponds to the absorption of 83 ergs or approximately 2μ cal of roentgen energy in one gram of tissue.

Grebe, on the other hand, suggests that it be worded as follows: The absolute unit of the roentgen-ray dose is delivered by that amount of roentgen rays which produces in 1 c.c. of air irradiated homogeneously (0° centigrade and 760 mm. Hg. pressure), an ionization equivalent to 2.09 milliards of single charged pairs of ions.

ERNST A. POHLE, M.D., Ph.D.

A Roentgen Meter for Small Intensities of Radiation. Josef Frank. Strahlentherapie, 1934, **50**, 687–692.

The author describes a sphere-shaped measuring instrument designed for the determination of small doses of roentgen rays. It is particularly fitted to test the degree of protection in x-ray laboratories since doses of 10^{-5} to 10^{-9} r per second can be measured with satisfactory accuracy.

ERNST A. POHLE, M.D., Ph.D.

ESOPHAGUS (THERAPY)

Carcinoma of the Esophagus Treated by Radiation. F. J. Cleminson and J. P. Monkhouse. Jour. Laryngol. and Otol., May, 1934, p. 313. Reprinted by permission from the British Med. Jour., July 28, 1934, p. 15 of Epitome of Current Medical Literature.

The authors report the results of radon treatment of 89 cases of carcinoma of the esophagus (excluding post-cricoid growths) in the Middlesex Hospital during the years 1925–32. They suggest that this treatment may be actually harmful, for these patients might actually live longer if their only treatment were preliminary removal of all teeth, followed by gastrostomy. As a rule they do not seek advice until peripheral extension of the malignant growth and early metastasis have made it impossible for the radiation to reach the outlying parts of the carcinoma with effective strength. It is even possible that there may be some danger of stimulation of the growth at the periphery, and the termination be thus hastened rather than delayed.

The mode of treatment was to perform first an esophagoscopy for diagnosis, with removal of a fragment of the growth for section. The patient was then examined by x-rays to determine the length of the stricture, the Trendelenburg position being essential for this procedure, for otherwise the lower end of the stricture is not defined. From this information the dose of radon to be used and the length of the applicator were deduced. At a second esophagoscopy the radon was placed in position and left for seven days. In several cases the ulceration disappeared after this treatment but columns of cancer cells were found in the subjacent lymphatics between the muscle bundles, if not also in the actual stricture substance.

The average survival period for the whole series was 5.6 months: for growths in the upper part, 6.7 months; the middle part, 5.4 months, and the lower part, 6.9 months. For the ten women it was 8.5 months and for the 79 males 5.2 months. The average length of the history of dysphagia was: for women, 5.4 months and for men, 3.8 months, women having thus a longer history and a longer survival period. A short history does not, therefore, indicate that the case can be considered early. It would seem that a preliminary gastrostomy might be beneficial, especially if preceded by removal of all remaining teeth. Increasing the dose of radon was associated with an even shorter period of survival, and the optimum dose appeared to be a moderate one of about 5 mc. to the inch, screened by 0.5 mm. of platinum. The authors add that deep x-ray therapy may be a more promising line of treatment.

FOREIGN BODIES

Ingestion of Foreign Bodies: Clinical-radiological Considerations. Marcelo H. Moreau and Oscar F. Noguera. Semana Médica, April 26, 1934, p. 1318. Reprinted by permission from the British Med. Jour., July 28, 1934, p. 14 of Epitome of Current Medical Literature.

The authors, collating their experience with that of surgeons all the world over, unhesitatingly condemn precipitate operation in the above condition, and stress the importance of frequent "screening," which should never be omitted in cases about to be operated upon after the anesthetic has been administered, as it has been proved that a foreign body, long stationary in the stomach, has frequently passed through the pylorus while the patient is "going under." One of the three cases they report was a child of 20 months, who at noon on November 1 swallowed a slightly bent tiepin, 5.5 cm. long, with a small glass ball at one end. On screening at 3 P.M. the pin was seen to be in the stomach, but at 3:30 P.M. gastrotomy disclosed an empty stomach. On November 3 the pin was seen in the

right iliac fossa, and on the fourth at the hepatic flexure of the colon. On the fifth the patient was lipothymic, with rapid pulse and cold sweats, but in the early hours of November 6 the pin was passed without any trouble.

These authors state that the surgeon's best policy is one of watchful expectancy, always remembering the size of the various portions of the duodenum, and if in doubt, waiting rather than operating. Purges and massage should be avoided. Feeds of wholemeal bread, boiled lentils, peas, and beans (dried) with mashed potatoes can be given. Once the duodenum is passed all fears may be put aside; but it should not be forgotten that this organ in a young child is fixed and will measure 15 centimeters.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Layer-formation of Bile as an Expression of Muscular and Resorptive Function of the Gall Bladder; Also a Contribution to Accelerated Cholecystography. A. Bernstein. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1934, **49**, 68–84.

On the basis of roentgenologic observation, physiologic information, and recent literature, the following cholecystographic technic was devised: Cleansing enema the preceding night; at 7 A.M., two raw egg-yolks; 8:30 A.M., 0.001 g. atropine subcutaneously; 9 A.M., 4 g. tetraiodophenolphthalein dissolved in 40 ccm. of 40 per cent glucose solution intravenously. Roentgenograms show highest concentration two to three hours after injection, in normal individuals. (Dye is to be dissolved in small amount of water, filtrated, sterilized, then added to sterile glucose solution, and mixed: no sterilization after mixing as it will produce decomposition and precipitation.)

Roentgenograms are made in upright and prone positions. The former regularly show layer formation of bile, with iodine-containing bile in fundus. Very rarely does complete evacuation of bile take place after ingestion of food. Newly inflowing liver bile must be specifically lighter than concentrated gall-bladder bile.

Interesting speculations are deducted from these observations. Experiments with this technic and cholecystograms in erect posture would seem worth while.

H. A. JARRE, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

A Large Fecalith Containing Bismuth as a Complication of Hirschsprung's Disease. Akos Kovacs. Röntgenpraxis, March, 1934, **6**, 164–166.

Large fecaliths have repeatedly been described in the literature. They may lead to as serious complications as complete obstruction and perforation. A man 53 years old had been constipated as long as he remembered. Some years previously the roentgenologic diagnosis of megalocolon had been made. The present complaints of the patient were severe constipation, loss of appetite, and loss of 16 pounds in weight during the last year. One could feel a large, slightly movable mass, the size of a child's head, in the pelvis. Proctoscopy was negative. A flat film of the pelvis showed a large, well defined opaque shadow with a concentric structure; it was surrounded by gas. The diagnosis rested between a fecalith and a large benign calcified tumor. At operation a fecalith weighing 740 grams was removed from the sigmoid. It contained a large amount of bismuth, apparently from the barium enema administered four years previously.

HANS W. HEFKE, M.D.

Contribution to the Roentgenologic Diagnosis of Sarcomas of the Small Intestines. H. J. Busche. Röntgenpraxis, March, 1934, **6**, 141–145.

Two cases of sarcoma in the upper portions of the small intestines are described, in both of which there were roentgenologic symptoms of partial small intestinal obstruction, and in one of which the filling defect could be demonstrated. Histologic examination showed a polymorphous round-cell sarcoma in both instances. It is necessary to make the examinations rather more often than in the usual case in order not to miss the lesion.

HANS W. HEFKE, M.D.

GENITO-URINARY TRACT (THERAPY)

X-ray Treatment of Diseases of the Genito-urinary System. G. Harrison Orton. British Med. Jour., Aug. 25, 1934, No. 3,842, 343–346.

The author briefly reviews the general principles of x-ray therapy and discusses the treatment of diseases of the genito-urinary tract by means of the x-ray.

There is a good deal of controversy and confusion as to what is implied by a unit skin dose. The number of r units considered necessary to produce an erythema dose and the grade of erythema produced vary considerably in various clinics. The author's erythema dose consists of a dose of x-rays which, when applied to the skin of the abdomen of an adult, produces a slight redness within three weeks after the application, followed by some bronzing or pigmentation of the skin, but no desquamation. While this dose is at least 25 per cent less than that often given, the preservation of the integrity of the skin should be considered very important and the number of ports of entry increased wherever possible rather than run the risk of causing damage.

Several methods of employing irradiation therapy are available. The fractional dose, the oldest method, consists in giving fractional doses of one-third to four-fifths of the unit skin dose at intervals of a few days, or a week, and keeping it up for a considerable period of time. The single massive dose method is the application in a single dose of the largest dose which the tissues will tolerate. The divided, or split, dose method is a modification of the massive dose method in which the dose is spread over an interval of time. The saturation method consists of the maintenance of the effects of the treatment by giving further daily doses, after the maximum dose has been given. The

protracted fractional dose technic (Coutard), according to Schumacher, has allowed him to give from 2,000 to 2,500 r to the bladder and intestines with little reaction of these organs.

The author is of the opinion that when it is decided to give large doses they should be so regulated as to avoid as much as possible, any lowering of the general resistance of the patient. To accomplish this the following are considered important: The ports of entry should be as small as is compatible with efficient radiation; the shortest route to the lesion should be chosen; the patient should be protected from scattered radiation, and, if on a trial dose there is any upset, the intervals between the doses should be increased from one to two, three, or more days, regulating the dose accordingly, rather than risk lowering of vitality.

In the irradiation treatment of kidney conditions it is believed that no attempt should be made to give massive doses. In the application of divided doses the effect on the patient should be carefully watched. While surgery is believed to be the method of choice in growths of the bladder, the author believes that in the case of growths unsuitable for operation, or in recurrent tumors, x-ray treatment should be tried. He suggests spreading the dose over a period of from ten days to two weeks.

Simple enlargements of the prostate are treated through six ports of entry, three anterior and three posterior. Malignant prostates are treated through the six fields, with the addition of a perineal field, using an erythema dose to each field. Growths of the testicle should be treated by surgery followed by postoperative radiation. Tuberculous epididymitis responds favorably to small doses of x-rays.

J. N. Ané, M.D.

Technic and Results of Vesiculography. A. Puigvert Gorro. Jour. d'Urol., March, 1934, p. 193. Reprinted by permission from British Med. Jour., June 30, 1934, p. 102 of Epitome of Current Medical Literature.

The author points out the difficulty previously experienced in obtaining an x-ray exposure of the seminal vesicles, which have been visible only in cases in which there is a calculus or cystic lesion, or in which a tumor is in the process of calcification. In order to obtain a good result it is necessary to inject a contrasting medium, and it has been found that neo-iodipin answers this purpose. It is neither toxic nor painful—even if remaining for some time in the seminal vesicles—while good aseptic results are obtained. It is possible to fill the vesicles by four different methods: by catheterization of the ejaculatory ducts by urethroscopy; by transrectal or perineal puncture of the seminal vesicle; by subcutaneous puncture of the vas, or by puncture of the vas by the scroto-inguinal route. Of these methods the first is often unsuccessful, the second and third are uncertain and dangerous, and it is thus by the last method that good results have been obtained. The success of the procedure depends on the technic, which the author fully describes and illustrates. The operation is carried out under local anesthesia, a 10 per cent solution of novocain being used. An incision is made at the root of the scrotum, and the opaque liquid is injected into the vas until the patient desires to urinate, thus showing the passage of the fluid from the vesicle into the prostatic urethra and into the bladder. This usually occurs after from 2 to 3 c.c. has been injected. The incision is closed, and the patient expels any surplus fluid. The x-ray film can then be taken with the patient on his back. The fluid injected often remains in the vesicular cavity for several days, or even weeks, without causing discomfort.

By this means it is possible to obtain an accurate diagnosis in cases of malignant tumors of the prostate, retrovesicular and retroprostatic tumors, and in chronic inflammatory conditions of the vesicles.

HAY FEVER

Further Results in Roentgen Therapy of Hay Fever. H. Th. Schreus. Strahlentherapie, 1934, **50,** 462–467.

The author recommends from 15 to 20 per cent H.E.D. every ten to fourteen days during the hay fever season (6 × 8 cm. field, 0.5 mm. Cu applied over the nose). During the period from 1930 to 1933, 48 patients were treated but only 35 answered the follow-up questionnaire. Six were well, nine considerably improved, seven somewhat improved, while the remaining thirteen did not receive any benefit from the treatment.

Ernst A. Pohle, M.D., Ph.D.

KNEE JOINT

Tuberculosis of the Knee Joint: A Comparison of its Morbid Anatomy with its Roentgenological Manifestations. Ralph K. Ghormley, B. R. Kirklin, and Ernest A. Brav. Am. Jour. Roentgenol. and Rad. Ther., December, 1933, **30,** 747–755.

This paper is based on a study of the pathologic material obtained from 113 knee resections and 7 leg amputations, from which group of cases there were 77 with available roentgenogram studies. In the series of 77, 65 were tuberculous lesions and 11 were non-tuberculous arthritics. Correlation of the roentgenologic and pathologic findings disclose the fact that in the very early cases the x-ray appearances of the knee are apt to be normal. Later on, as the disease progresses, the x-ray becomes frankly abnormal, the changes being bone atrophy, haziness of joint structures, marginal erosion of bone, thinning or interruption of articular cortex, at times bone abscess or sequestrum formation, and late preservation of joint cartilage. Differentiation between tuberculous and non-tuberculous disease in the knee joint is often impossible, although early complete destruction of joint cartilage, a wider involvement of bone than the margins of the areas of pressure, articular lipping, non-existence of abscesses, tendency toward generalized or spotted hypertrophy, are the appearances one more regularly encounters in non-tuberculous infection. In the late stages of each type of involvement the x-ray differentia-

tion again becomes impossible. One important advantage of routine film study is the detection of bone lesions which otherwise may remain hidden beneath superficial disease of the synovia or even beneath normal tissues.

J. E. HABBE, M.D.

THE OVARIES

Formation of Hydrometra Following Post-operative Radium Treatment in a Case of Ovarian Carcinoma. E. Vogt. Strahlentherapie, 1934, **50,** 683–686.

A woman of 33 years of age was seen in June, 1931, with a tumor the size of a child's head located to the right and posterior to the uterus. Laparotomy revealed a carcinoma in both ovaries. X-ray therapy was given two weeks after operation and in October, 1931, radium was applied (1,800 mgh. intra-uterine and 400 mgh. in the vagina). Roentgen therapy was also given. The patient remained well until August, 1933, at which time the abdomen was considerably enlarged and operation revealed a hydrometra containing 200 c.c. of fluid. There were no metastases.

ERNST A. POHLE, M.D., Ph.D.

RADIATION EFFECTS

The Rôle of the Sympatheticus in Radiation Therapy. Walter Altschul. Strahlentherapie, 1934, **50,** 669–676.

Dermatologists years ago suggested irradiation of the spinal cord in the treatment of certain skin disorders. We believe now that the effect is due to an action of the radiation on the sympathetic nervous system. The results obtained by irradiation in gastric and duodenal ulcer, in bronchial asthma, and in certain endocrine disturbances may also be explained by the same mechanism.

ERNST A. POHLE, M.D., Ph.D.

RADIOLOGY, PRACTICE OF

The Radiology of Living Anatomy. James F. Brailsford. British Med. Jour., June 2, 1934, No. 3,830, 984–986.

The author stresses the great importance of including a course of "radiology of living anatomy" in the curriculum of medical students. This course of instruction should begin with a thorough study of roentgenograms taken in standard positions, and of normal structures at different periods from infancy to old age. In this manner only will sufficient knowledge of the variations observed in normal anatomy be obtained, such as is so necessary for correct interpretation of roentgenograms.

In the study of the skull by this method of examination the greatest amount of care should be used to obtain standard positions. The author cites the case of a child with a swelling at the angle of the mandible which was considered, from x-ray examination, to be a sarcoma. It was later proved that the shadow observed on the film was that of the hyoid bone and that the swelling was due to mumps.

Roentgenograms of the thorax, when they are to be compared, should always be made during the same respiratory phase. The shadows produced by the pressure of the breasts in contact with the film should be properly studied and care must be taken not to misinterpret these shadows as pathologic areas within the chest. The normal acromio-clavicular joint has often been confusing, so that fractures were incorrectly diagnosed in this region.

The essential part of the study of the gastro-intestinal tract consists of the fluoroscopic examination after the administration of barium sulphate. It is important that a thorough preliminary roentgenologic study be made of the abdomen before the administration of the opaque medium, to determine the presence of abnormal shadows. The gall bladder and biliary tract are best studied after the administration of the dye. Misinterpretation of areas of gas in the duodenum for negative shadows due to gallstones should be avoided. Serial roentgenology is an extremely valuable method of examination which should be employed when indicated. The interval of time between roentgenograms varies from a fraction of a second in the case of a gastro-intestinal study to a month or several months in the study of the development of the skeleton.

There is a limitation to the employment of fluoroscopy in teaching, and the author considers cine-radiography a valuable substitute. This method consists of both direct and indirect cine-radiography. In the direct method the patient is placed in front of an x-ray tube and against a leaded screen containing a window opposite the area to be studied. Behind the screen a large roll film is fixed and exposures are made on the rapidly changing film surface at the rate of sixteen exposures a second. Reduced films capable of fitting into a cine-projector are then made from the original films. The ability to better study the larger films by this method is an advantage over the indirect method, but since the cost of the direct method is considerable it will probably never come into general use. The indirect method depends on a cine-photographic record of the images produced on the fluorescent screen.

J. N. ANÉ, M.D.

The Future of Radiology as a Medical Specialty. Henry K. Pancoast. Am. Jour. Roentgenol. and Rad. Ther., December, 1933, **30,** 711–717.

The requirements of specialization in radiology are probably greater than in any other medical specialty with the exception of the major branches of medicine and surgery. The purely technical phases of radiologic practice must often be delegated to the technician if the radiologist is to give adequate time to interviewing patients, roentgenologic interpretation, consultations, planning treatments, working out new technical procedures, teaching, writing, and keeping up with the endless literature of the subject. For the elevation of the standards of radiologic practice, all should have a certain minimum of clinical experience as a background,

be particularly well informed in the field of pathology, and finally familiar with both the wide range of normal appearances and the characteristic and atypical appearances of the numerous disease processes wherein the x-ray is useful. Radiologists offering post-graduate education should be morally bound to select for their students only those with desirable personalities and high abilities. Anatomists, pathologists, physicists, and research workers, as well as clinicians, have aided greatly in the upbuilding of this specialty.

J. E. HABBE, M.D.

Influences Affecting the Future of Roentgenology. John T. Murphy. Am. Jour. Roentgenol. and Rad. Ther., December, 1933, **30**, 718–722.

In the opinion of the author, roentgenology is at a fork in the road: it may be absorbed in the general practice of medicine, it may be split up into a number of specialties, or it may remain as a separate medical specialty. As much effort should be expended to-day to keep roentgenology a separate specialty as has been used in the past to advance it scientifically. Roentgenology, which to-day fills an important place in the practice of medicine, will in the future suffer scientifically unless it is treated by the other specialties on an equal scientific and economic basis. The recent organization of the Board of Radiologic Examiners should help to elevate the standards of roentgenology in the future.

J. E. HABBE, M.D.

RADIUM

The Effect of Radium Emanation Treatment on the Alkali Reserve of the Blood. Siegfried Becker. Strahlentherapie, 1934, **50**, 468–470.

The author studied the alkali reserve of the blood in 15 patients, three of whom received the radium emanation *per os*, two *per enema*, and ten in the form of inhalations. He noticed a definite decrease of the alkali reserve 13 times, the average drop being 10 per cent. One case did not show any changes and in one a slight increase occurred. This drop lasted several weeks (four weeks in the average case), but returned to normal after that time. No correlations between subjective reaction and the degree of change in the alkali reserve could be found.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Intravenous Radon Injection on the Blood. M. Nemenow and R. Gurewitsch. Strahlentherapie, 1934, **50**, 693–704.

The effect of intravenous radon injection on the blood was studied in 25 rabbits. Blood counts were done from three to seven times in each animal before injection. The normal values were from 3,500,000 to 4,500,000 red blood cells, from 45 to 70 per cent hemoglobin, from 7,000 to 12,000 leukocytes. From 10 to 435 mc. were given at a single sitting—it appeared that from 130 to 150 mc. were fatal for an adult rabbit. The number of leukocytes dropped after the injection of from 20 to 30 mc. of radon, the drop beginning from thirty minutes to one hour after the injection. An occasional leukocytosis is seen from one to two hours, and sometimes twenty-four hours, after the injection. If given moderate doses the lowest level of leukocytes is reached after from four to six days and returns to normal within from twelve to twenty days. Studies of the differential count showed that the decrease of the leukocytes was due to the drop in the number of lymphocytes. The process of regeneration manifests itself by the appearance of large and medium sized lymphocytes in the blood stream. The number of the red blood cells showed no significant changes. Histologic examination of lungs and kidneys did not reveal definite injuries.

While the use of intravenous radon injection in the treatment of malignant tumors seems, therefore, rather doubtful, it may have possibilities in the treatment of leukemia, particularly of the lymphatic type.

ERNST A. POHLE, M.D., Ph.D.

Observations Concerning Unequally Filled Radium Preparations. A. Pickhan and K. G. Zimmer. Strahlentherapie, 1934, **50**, 516–519.

A number of tests on radium needles and radium screens showed that very often the radium salt is not evenly distributed throughout the applicator. Photographic tests are, therefore, suggested to check up on the distribution of radium salt in radium applicators to assure proper dosage.

ERNST A. POHLE, M.D., Ph.D.

THE SPINE

Roentgen Therapy in Spondylarthritis Ankylopoetica. F. Haenisch. Strahlentherapie, 1934, **50**, 623–640.

The author treated 13 cases of spondylarthritis ankylopoetica by radiation therapy. Technic H.V.L. in Cu, 0.9 mm., field 10 × 12 or 10 × 15 cm., 5 times 130 r per field with an output of from 28 to 35 r per minute, intervals between fields from 5 to 10 days. Series may be repeated after six months. Ten patients responded well to the treatment.

ERNST A. POHLE, M.D., Ph.D.

THE THORAX

An Unusual Observation on a Spontaneous Pneumothorax. G. F. Haenisch. Röntgenpraxis, March, 1934, **6**, 147–150.

During a fluoroscopic examination of a chest on account of indefinite complaints, a complete pneumothorax was discovered in deepest expiration—it disappeared again in inspiration, a phenomenon which could be duplicated at will. Films taken in inspiration and expiration showed also the same picture. Such an occurrence has to the author's knowledge never been described in the literature. An explanation might be that a small pneumothorax had been caused by overexertion and that it surrounded the lung in a thin layer

and was not visible during normal respiration. The unusually marked decrease in the pleural space on deep expiration must have caused a complete collapse of the lung even by a comparatively small amount of air in the pleural cavity. It seems advisable to examine patients with a suspected pneomothorax in deep expiration also.

HANS W. HEFKE, M.D.

TUBERCULOSIS, PULMONARY

Failures of Roentgen Sterilization in Cases with Tuberculosis of the Lungs. F. v. Mikulicz-Radecki. Strahlentherapie, 1934, **50,** 658.

An analysis of the records of 16 women sterilized by roentgen rays showed that from 270 to 329 r effective in the ovaries were necessary to produce results. The age has a definite influence on the doses required—younger women need more radiant energy. A follow-up showed that in three cases pregnancies occurred, at eight months, two years, and six years, respectively, after irradiation. Since this is a very undesirable occurrence, the author recommends the use of operative sterilization as the method of choice.

ERNST A. POHLE, M.D., Ph.D.

TUMORS (DIAGNOSIS)

The Diagnosis and Treatment of Intrathoracic Tumors of Neural Origin. M. Makkas. Bruns' Beitr. z. klin. Chir., March 14, 1934, p. 276. Reprinted by permission from the British Med. Jour., June 30, 1934, p. 102 of Epitome of Current Medical Literature.

The author gives an account of two personal cases and 26 from the literature of operation for intrathoracic neural tumor, comprising ten ganglioneuromas, nine neurofibromas, eight neurinomas, and one sympatheticoblastoma. With the exception of one neurofibroma, which had become sarcomatous, all were benign: all but one were found in the posterior mediastinum (usually high up), and three out of four affected females. There was no special age incidence, except that ganglioneuroma in the great majority of cases occurred below the age of 20. The source of the tumor was frequently undetermined, but appeared as a rule to be the sympathetic cord or an intercostal nerve. The largest diameter of the tumors ranged from 3 to 20 cm. Clinically, a long history (two to twenty years) of slight and indefinite symptoms was usual—slight pain, dyspnea, or dry cough. Intercostal neuralgia was reported in two cases only. Physical signs of dullness and impaired air entry led to suspicion of chronic pulmonary or pleural inflammation in most cases; but diagnosis was sometimes aided by detection of a supraclavicular extension of the tumor (four cases) or a unilateral ptosis and myosis pointing to sympathetic palsy.

In no case was diagnosis made before radiography, but in no case did this fail to show the tumor; however, it was not seldom regarded as being probably a dermoid or hydatid cyst. Differential diagnosis from malignant tumor is not long difficult. From a dermoid cyst, which also has a sharp, rounded outline, neurogenous tumors are distinguished by their occurrence in the posterior mediastinum: from a hydatid cyst, by their broad inner margin, flat or non-concave internally toward the vertebral axis, and by the negative Casoni reaction.

At operation, posterior mediastinotomy is preferable; the tumor shells out without difficulty, and serious hemorrhage has not been noted. Opening of the pleural cavity is usually unavoidable. Sauerbruch recommends that in operations on tumors of sympathetic origin a posterior portion should be left behind—otherwise a lethal tachycardia may occur. The mortality in this collected series was 32 per cent, and pleuropulmonary complications followed in about one-half.

The Roentgenologic Examination of the Osseous Orbit. Georg Steiner. Röntgenpraxis, March, 1934, **6,** 150–157.

Pathologic changes of the osseous orbit are often very difficult to diagnose roentgenologically, especially in the early stages. Normal differences in structure and opacity are confusing. A radicular cyst is described which elevated and eroded the inferior wall of the orbit. An hemangioma which extended toward the median fossa and destroyed portions of the hard palate had also raised the floor of the orbit and led to destructive changes in it. Fractionated roentgen therapy improved the condition markedly. The case of a questionable fracture of the ala magna is described in detail and the difficulties in diagnosis are pointed out.

HANS W. HEFKE, M.D.

The Significance of the Displaced Calcified Pineal Body for the Roentgen Diagnosis of Brain Tumors. E. Woerner. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1934, **49,** 499–512.

Observations of Vastine and Kinney are extensively quoted. On their basis two cases of brain tumor were successfully localized. A third case of displacement by cicatricial retraction following trauma by a shell fragment is also shown.

H. A. JARRE, M.D.

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